CIVIL ENGINEERING

OCTOBER 1950

THE MAGAZINE OF ENGINEERED CONSTRUCTION

CANTILEVER CONSTRUCTION of central suspended span for double-track Southern Railway Bridge over Cumberland River in Kentucky approaches closure. See article by J. K. Akers.

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Effects of Cross Pressure on Bridge Cables Tested—C. D. Meals

Hydraulics Division Holds First Separate Meeting—Jackson, Miss., Nov. 1-3

Concrete Runway Constructed for Berlin Air Lift—Willard C. Jensen

Raymond

MAKES 5 TYPES OF CONCRETE PILES

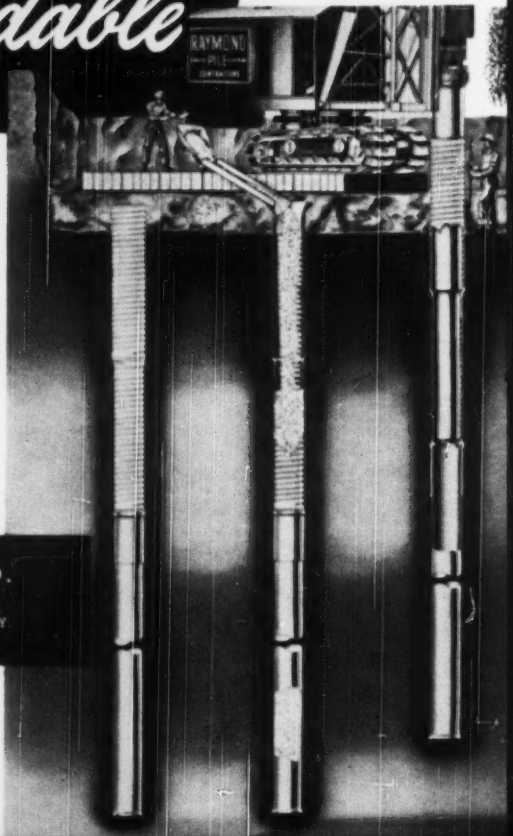
1. STANDARD . . . 2. STEP-TAPER . . . 3. PIPE STEP-TAPER
4. COMPOSITE . . . 5. GOW CAISSONS

Raymond installs every type of pile: cast-in-place concrete, precast concrete, steel pipe, wood and H-beam. Raymond operations include underpinning, borings and soil investigations, waterfront construction and harbor and river improvements; also cement mortar lining of pipes by the Centriline Corporation, a Raymond Subsidiary.

3. PIPE STEP-TAPER PILES

Deep and Dependable

At the right, the pipe step-taper pile is being driven with the rigid steel mandrel. In the center the shell and pipe are being filled with concrete after having been driven to satisfactory resistance and inspected. At the left is a completed pipe step-taper pile.



Raymond Pipe Step-Taper Piles are composed of an upper section of Step-Taper Shell Pile and a lower section of closed-end steel pipe pile. These piles are generally used to penetrate thick beds of soft soil to reach hard bottom at depths as great as 150 feet or more. The pipe step-taper pile is a most dependable pile available for reaching hard ground at great depths.

Raymond's methods result in efficiencies and substantial savings that are well worth investigating. Consult our engineers for more detailed information.

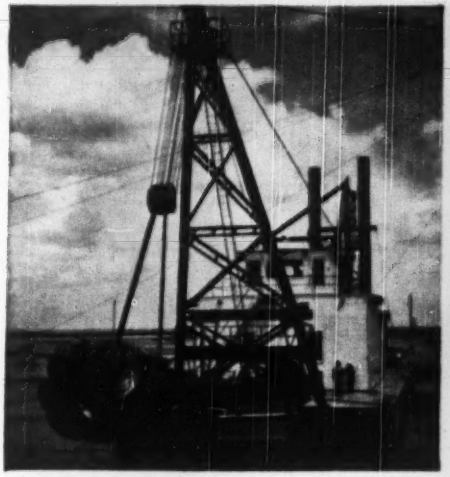
RAYMOND PILES MAINTAIN DRIVING RESISTANCE

Raymond CONCRETE PILE CO.

140 CEDAR STREET, NEW YORK 6, N. Y.

BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America

View above shows Bucyrus-Erie *hydraulic* dredge installation at work. In foreground on floats are electric cables which supply 6600-volt, 3-phase power to the 4000-hp pump motor, 500-hp cutter motor, and various other motors and control. Below is front-view close-up showing cutter in raised position.



Inside, these hoist cable drums are driven by G-E motors. After ten years of rough duty, this fully electrified dredge continues to give top performance for its owners.

Vacuum-cleaning RIVERS ... *Electrically*

This electrically driven hydraulic dredge is a pretty rugged looking "vacuum cleaner." But biting-into and sucking-up river bottoms is a rugged job—though it does require accurate control. That's why Bucyrus-Erie uses *electric drives* in most dredge installations.

Electrified construction equipment is being used more and more to handle difficult jobs—jobs that require smooth, completely dependable operation. With G-E power distribution systems supplying the voltage and G-E motors and control driving your equipment, you are assured of all the benefits of electrification plus G-E engineering assistance in application, installation, and service—wherever the job may be. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

GENERAL ELECTRIC

664-11

CIVIL ENGINEERING, October, 1950. Vol. 20, No. 10. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 25, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

GET MORE POWER

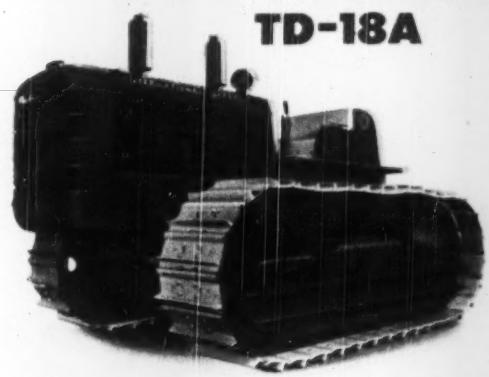
INTERNATIONAL HARVESTER

INTERNATIONAL

than we claimed!

ADVERTISED ~~87~~ DRAWBAR HORSEPOWER

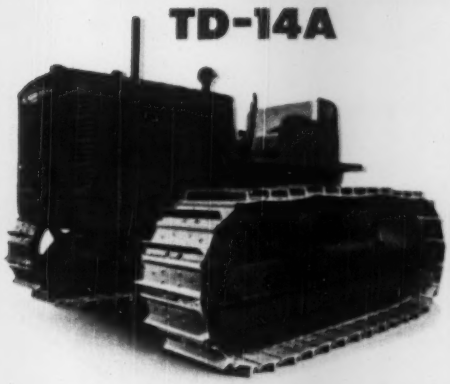
OFFICIAL TEST **89.29** DRAWBAR HORSEPOWER



TD-18A

ADVERTISED ~~60.5~~ DRAWBAR HORSEPOWER

OFFICIAL TEST **65.90** DRAWBAR HORSEPOWER



TD-14A

INTERNATIONAL DIESEL CRAWLERS GIVE YOU A BONUS OF POWER

Official tests of the three latest models of International crawlers show how conservative International Harvester's advertised horsepower ratings have been.

A board of university engineers tested each of the tractors illustrated and found that it had substantially higher drawbar horsepower than we had claimed—as shown in the figures, above.

No wonder owners have found that International crawlers outwork every other tractor of similar size. No wonder the giant TD-24 has stolen the show on every big job it has tackled.

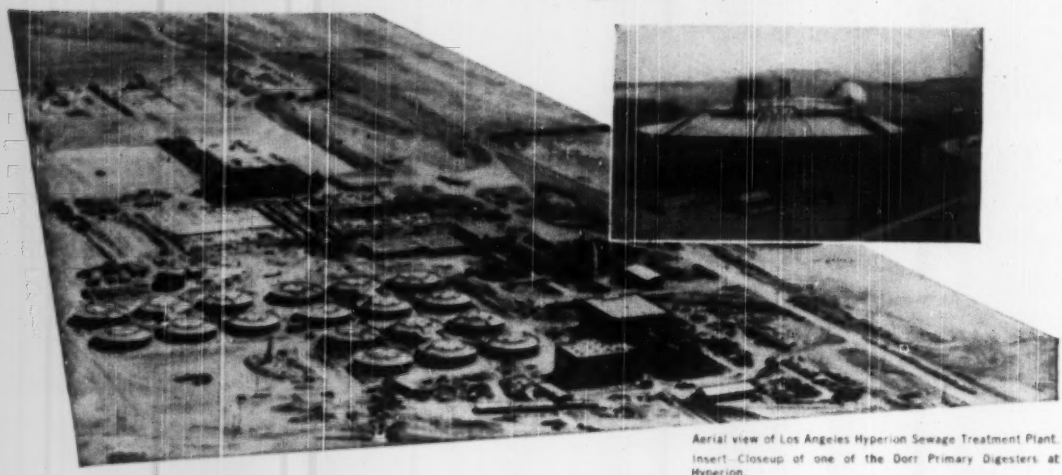
It is the policy of International to deliver more for the money than buyers expect. That's why you get a bonus—not only in horsepower but also in product quality—every time you buy International.

Ask your International Industrial Power Distributor, or write direct, for copies of the official test reports to aid you in your equipment planning.

INTERNATIONAL HARVESTER COMPANY • CHICAGO

INDUSTRIAL POWER

Interested in BIG SCALE sludge digestion?



Aerial view of Los Angeles Hyperion Sewage Treatment Plant. Insert: Closeup of one of the Dorr Primary Digesters at Hyperion.

HERE ARE TWO EXAMPLES of recent Dorr Multdigestion installations . . . built for big capacity . . . at a reasonable installed and operating cost:

For the 245 MGD Los Angeles Hyperion Plant

. . . 18 Dorr Digesters, each 110'-11" in diameter have recently been placed in operation. The 12 Primaries are each equipped with three draft tubes and high capacity mixers . . . the six Secondaries provide for quiescent settling.

For the 25 MGD Oklahoma City Southside Plant

. . . two Dorr Multdigestion Systems are nearing completion, each with three Primaries and one Secondary. All eight tanks are 90' in diameter. 100,000 cu. ft. of gas storage is provided. Each Primary is equipped with three high capacity mixers to dissipate scum and speed-up digestion.

Dorr Multdigestion . . . providing thorough mixing of raw and digested sludge . . . is the ideal answer to big scale digestion problems. If you don't already have Bulletin #6261, write for a copy today. It contains 60 pages of detailed information on all types of Dorr Digesters.

AND BEAR IN MIND . . . for communities where single-stage digestion is applicable, the Dorr Type MA Digester combines the advantages of high-capacity mixing and gas storage in a single unit. Bulletin #6591 describes this modern unit and will be sent on request.

DORRCO

THE DORR COMPANY, ENGINEERS
BARRY PLACE, STAMFORD, CONN.
NEW YORK • ATLANTA • TORONTO
CHICAGO • DENVER • LOS ANGELES
RESEARCH AND TESTING LABORATORIES
WESTPORT, CONN.
SUGAR PROCESSING
PETREE & DORR DIVISION, STAMFORD, CONN.
ASSOCIATES AND REPRESENTATIVES
Dorr Technical Services and Equipment Are Also Available Through Associated Companies and Representatives in the Principal Cities of the World. Names and Addresses on Request.

DORR

RESEARCH ENGINEERING EQUIPMENT

Fort Pitt STRUCTURAL STEEL for the skylines of America

Bridges, Skyscrapers, Schools, Power Plants, Institutions, Plants—on the highways and the waterways you will see the Fort Pitt Structural Steel trademark—the mark of responsibility, integrity and experience. When structural steel is needed—*for any purpose*—contact Fort Pitt Bridge *first*.

FORT PITT BRIDGE WORKS

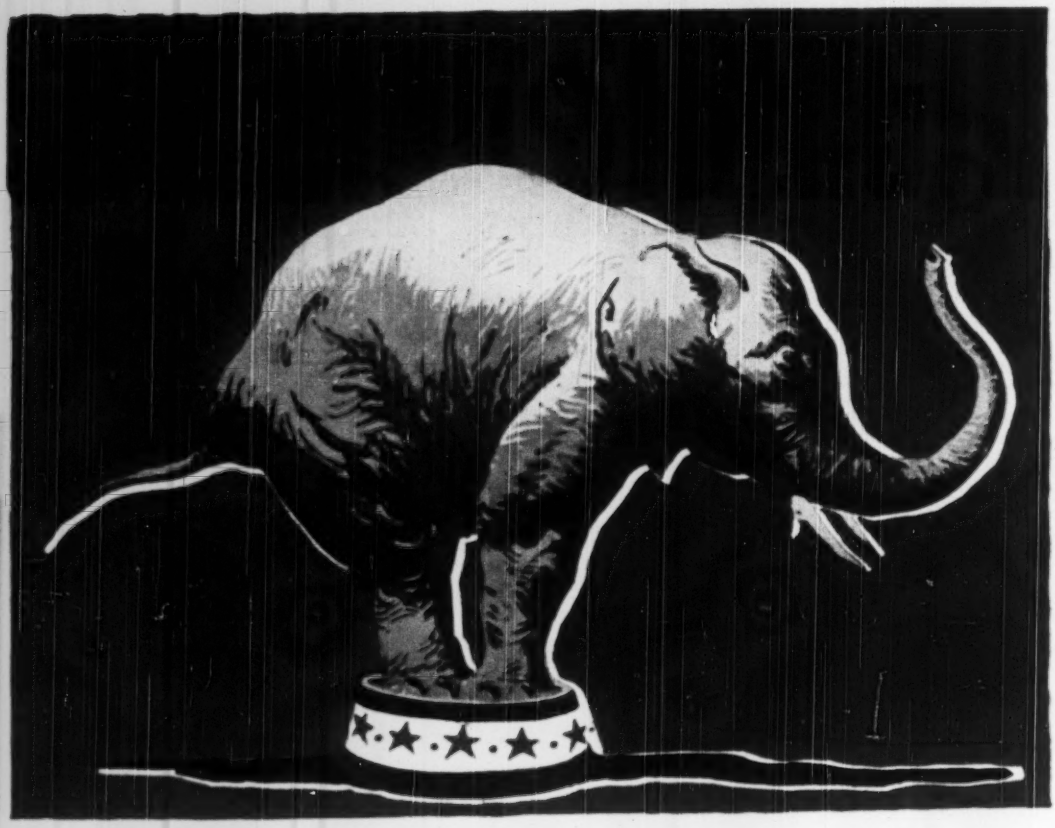
Member American Institute of Steel Construction

General Offices, Pittsburgh, Pa. . . Plant at Canonsburg, Pa.

BRANCH OFFICES

NEW YORK, N.Y., 441 Lexington Avenue
CLEVELAND, OHIO . . . . Sulkley Building
COLUMBUS, O., Huntington Bank Building
DETROIT, MICHIGAN, New Center Building

"Steel Permits Streamlining Construction with Safety, Endurance and Economy"



Without crushing strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in *city streets* would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada.

Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.

CAST IRON PIPE

Strength factors of Long Life !

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

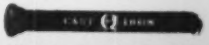
When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

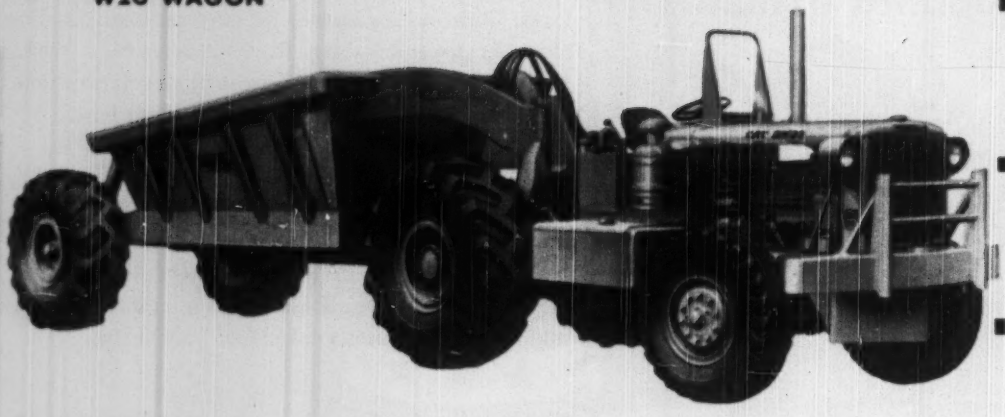
In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.



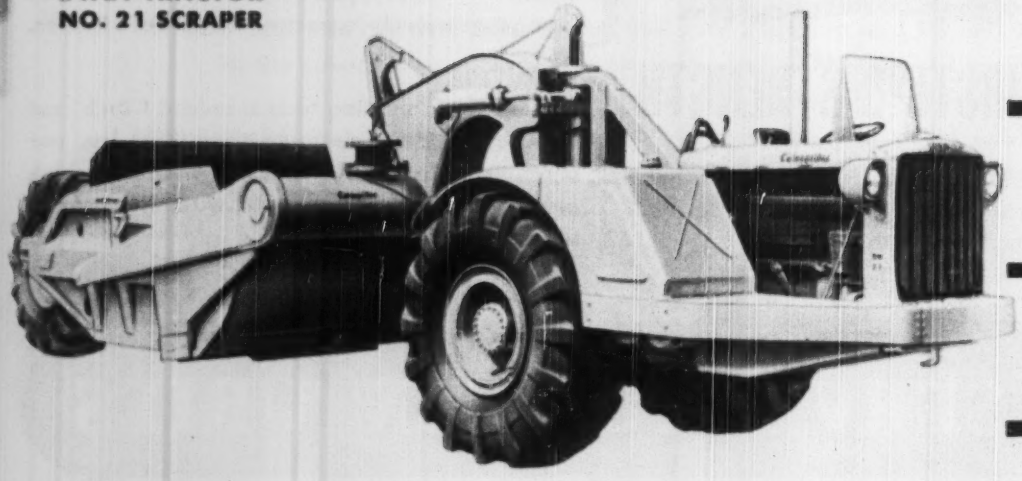
SERVES FOR CENTURIES

2 GREAT NEW ADDITIONS

DW20 TRACTOR
W20 WAGON



DW21 TRACTOR
NO. 21 SCRAPER



TO THE "CATERPILLAR" LINE

—TO BRING YOU STILL GREATER EARTHMOVING CAPACITY AND SPEED

Accompanying the Tractor features generalized (below, right) the Wagon member of this big-capacity unit offers:

17 cu. yds. capacity, struck; 25 cu. yds., heaped.

Travel speeds, through tractor's 5 gear ratios, ranging from 2.88 to 26.6 m.p.h.

Generous size hopper to provide good target for shovel or dragline loading.

Controlled dumping . . . openings can be varied without mechanical adjustment--permitting either dumping or windrowing.

Accurate hydraulically controlled dumping with positive mechanical lock on dump doors.

THE DW20 TRACTOR AND NO. 20 SCRAPER UNIT

The "Cat" No. 20 Scraper is available also for the DW20 Tractor. It has the same capacity and general specifications (except in type of gooseneck) as the No. 21 Scraper described below.

THE ENGINE: ***Both prime movers have the new 6-cylinder "Cat" Diesel Engine . . . 275 HP. peak capacity at 2,000 r.p.m. tested in accordance with A.S.M.E. Power Test Codes; 225 HP. at 1,900 r.p.m. available at the flywheel.***

Accompanying the Tractor features generalized (right), the 2-wheel DW21 offers:

Full 90° turn each way.

Travel speeds, through 5 gear ratios, ranging from 2.16 to 20 m.p.h.

Scraper capacity is 15 cu. yds., struck; 19½ cu. yds., heaped. (With available 12" extensions, 18 cu. yds., struck; 22½ cu. yds., heaped.)

Bowl and apron are designed to promote "boiling" action of earth through center of load—for full-measure yardage and minimum loading time.

Large low-pressure tires for easy load flotation.

'Dozer-type ejection for positive "kicking out" of sticky material; dependable spring-action ejector return.

Open bowl design to permit visible loading under shovel or dragline.

Adjustable rear axle to permit level cuts and desired settings.

Double bottom of special alloy steel. Self-sharpening reversible cutting edge.

High apron lift, low center of gravity.

FOR high-speed hauling . . . for high production . . . "Caterpillar" offers two new earthmoving units — the 4-wheel DW20 and the 2-wheel DW21.

With a completely new 6-cylinder Diesel Engine producing 225 HP. available at the flywheel, the newcomers give users their choice of high-speed wheel-type prime movers.

The DW20, with top speed of 26.6 m.p.h., has 2 design matched trailed units . . . the "Cat" W20 Wagon (25 cu. yds. heaped capacity) and the "Cat" No. 20 Scraper (19½ cu. yds. heaped capacity).

The DW21, with top speed of 20 m.p.h., trails the "Cat" No. 21 Scraper (19½ cu. yds. heaped capacity).

And, as always, "Caterpillar" quality, dependability, durability and work capacity are built in . . . backed by the unparalleled parts and service facilities of the world-wide "Caterpillar" dealer organization.

For further information on these two new units, contact your dealer or write the factory.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

TRANSMISSION

Constant-mesh transmission, and heavy-duty clutch. Special locking device that prevents gears from becoming disengaged.

BRAKES

Each large, heavy-duty brake is 22" in diameter, 7" wide. Compressed air energized brakes on both tractor and drawn member of unit. Handy control valves for applying both sets of brakes, and to right or left driving wheel.

STEERING

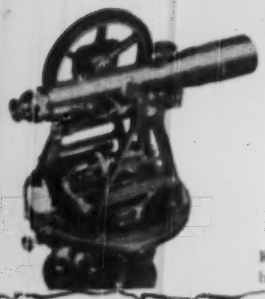
Hydraulic booster steering that follows the natural "feel of the road" hand guidance. Heavy steel stops for keeping gooseneck of drawn equipment from jackknifing.

OPERATOR COMFORT

Airfoam rubber cushion on bucket-type seat mounted on coil spring with hydraulic snubber. All controls within easy reach. Excellent visibility.

CATERPILLAR

DIESEL ENGINES • TRACTORS
MOTOR GRADERS • EARTHMOVING EQUIPMENT



WHAT A LEADING TECHNICAL EDITOR WROTE ABOUT ALUMINUM TRANSITS AFTER ANALYZING HOW GURLEY MAKES THEM

Reproduced from a full-length article in the December 1949 issue of MATERIALS & METHODS, written by H. R. Clauser, its Associate Editor. We will gladly send you reprints of the entire article on request.

Aluminum Used Successfully in Precision Instruments

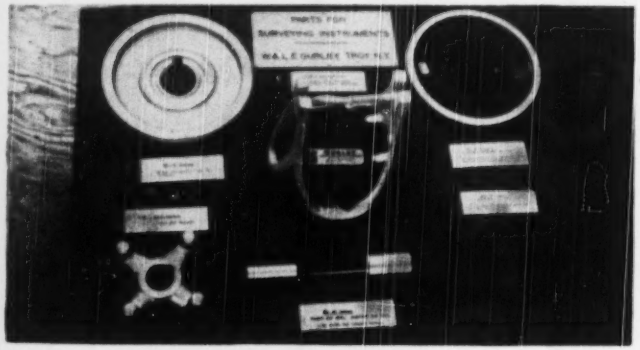
A PICTORIAL STORY

Requirements of accuracy during a long service life are controlling factors in selection of materials for engineering and surveying instruments.

• IN THE MANUFACTURE of precision instruments, the selection and careful processing of materials is of prime importance. Accuracy as well as long service life with a minimum of adjustment and repair are the quality standards that must be met, and to meet them, astute materials engineering coupled with expert workmanship are required. Perhaps no better example of the combination of these two factors can be found than at W. & L. E. Gurley, Troy, N. Y., where precision instruments are produced not only for engineering and surveying, but also for other fields such as meteorology and aeronautics.

Copper alloys and aluminum alloys are the principal materials used in the company's surveying instruments. One of the earliest uses of aluminum in this country was in a Gurley transit 73 years ago. And since that early application, aluminum has proved satisfactory in an increasing number of instrument parts. The main reasons for adopting the use of aluminum were: (1) light weight; (2) relatively high strength and yield point; (3) lends itself to precision machining; (4) good ductility; (5) relatively good corrosion resistance, especially in sulfur atmospheres; and (6) does not distort nor "grow" with age. The aluminum alloys most used at present are 14SW, 61ST, 356 and 13. A thorough test program insures against any differences in accuracy within a temperature range of —80 F and +165 F.

The accompanying pictures illustrate a number of the steps involved in the production of various parts making up the transit.



1—Shown here are the aluminum parts used in Gurley surveying instruments. At top, left and right is a 14SW forging for a horizontal transit limb before and after being machined, anodized and dyed. In the center is a sand casting of 356 alloy for the truss standard. Lower row, left to right, is a transit leveling head sand casting of 13 alloy, a swaged and spun tubing for telescope focusing slide of 51ST alloy, and a graduated vertical circle made of 61ST aluminum sheet which has been anodized and dyed.

You're So Right, Mr. Editor—

The first Gurley Aluminum Transit, built in 1876, was finally retired after 50 years of active service—and then for sentimental reasons only. It met every field "requirement of accuracy during a long service life"—as every Gurley Transit continues to do all over the world.

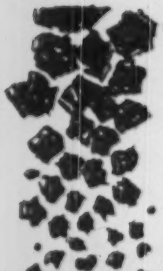
W. & L. E. GURLEY, 518 FULTON STREET, TROY, NEW YORK

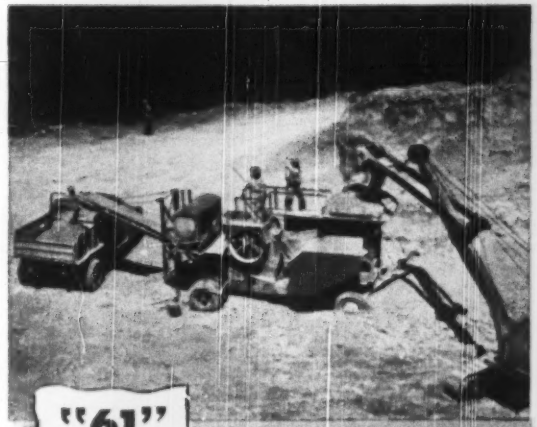
Surveying and Engineering Instruments, Hydraulic Engineering Instruments, Standard Precision Weights and Measures, Paper and Textile Testing Instruments, Reticle Making Facilities, Aeronautical Navigating Instruments, Meteorological Instruments

GURLEY

Surveying and Scientific Instrument Makers
Since 1845

MAKING LITTLE ONES OUT OF BIG ONES





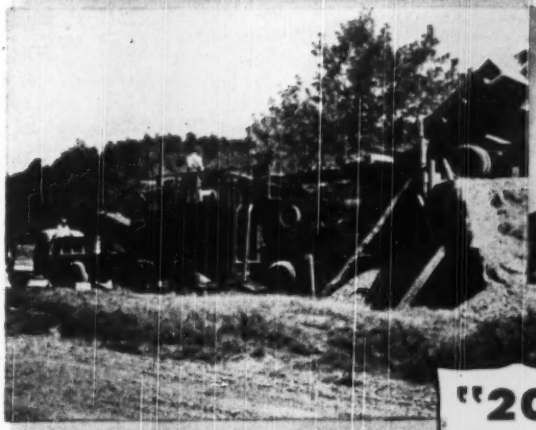
"61"

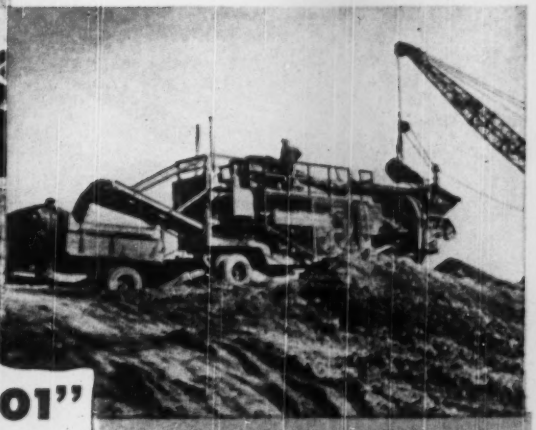
Designed for fast, economical production where extreme accuracy in grading to size is not required. Compact, lightweight and readily portable. Simple design and sturdy construction keep operating and maintenance costs at a minimum.

The AUSTIN-WESTERN LINE includes Jaw Crushers and Roll Crushers in a wide range of sizes; plus matching screens, elevators, conveyors and bins. Exclusive features increase output, assure constant operation and reduce maintenance costs. Skilled engineering characterizes each and every Austin-Western crushing, screening and washing plant, which is tailor-made to a particular production problem. We would welcome the opportunity to discuss yours.

AUSTIN-WESTERN COMPANY

Aurora, Illinois, U.S.A.



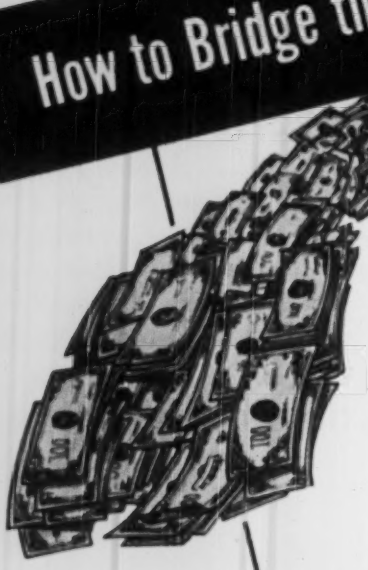


"201"

You'll like its READY PORTABILITY . . . CHOICE OF FEED . . . HIGH OUTPUT. The "201" is of a size and weight that can be transported over most highways without a special permit . . .

may be had with either elevated-loading hopper, or swivel drive for separate feed conveyor . . . is capable of producing especially large amounts of ¾" and smaller product.

How to Bridge the Gap in a Drainage Budget



Drainage dollars cover more ground when you use Armco Corrugated Metal Structures. Here's why.

There's a type and size for every need from a 6-inch round pipe to a 24-foot MULTI-PLATE Arch. You save in handling and hauling because Armco Structures are light in weight and often can be nested to save space.

Installation is economical, too. Long lengths of Armco Pipe mean fewer sections to lay, line and join. Simple band couplers assure speedy, positive connections. Jobs go fast with just a small crew. No special tools are required.

And here is something else. Nearly half a century of underground service proves the lasting economy of Armco Corrugated Metal Structures. They have ample strength and durability to serve for years with little or no maintenance.

Let us show you how easy you can save time and money on that next job. Call or write today. Armco Drainage & Metal Products, Inc., 3370 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation.

Export: The Armco International Corporation

ARMCO DRAINAGE STRUCTURES

230 days saved
by using reinforced concrete

IN NEW
Alabama
Livestock Coliseum

ARCHITECT: Sherlock Smith & Adams, Inc. ENGINEERS for the Roof Structure, Ammann & Whitney. BUILDER: J. A. Jones Construction Co.

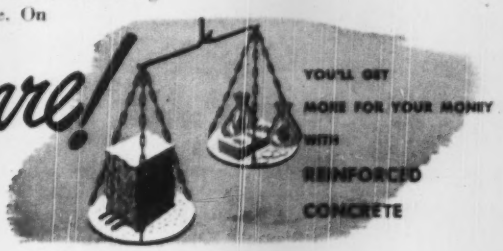
Construction time reduced
from 730 to 500 days

When this striking 1.5-million dollar Livestock Coliseum was being planned for Montgomery, Ala., the architects—Sherlock, Smith & Adams, Inc.—executed *two alternate designs* for the 286 ft clear span, thin-shell barrel roof and ceiling ribs. One design used structural steel, the other reinforced concrete. Bidding showed that concrete cost slightly less than steel. But it was *construction time* that made reinforced concrete the overwhelming choice. The estimate for concrete was 500 days—230 days less than structural steel!

Reinforced concrete not only requires less time to erect—it has many other advantages. It provides a rugged, durable monolith that is inherently firesafe, as well as highly resistant to wind, shock, and quakes. It costs less. And, reinforcing bars, cement, and aggregate are readily available. On your next building, it will pay you to consider reinforced concrete.

CONCRETE REINFORCING STEEL INSTITUTE
38 S. Dearborn Street
Chicago 3, Illinois

Compare!



This ECONOMY Pump WILL DELIVER

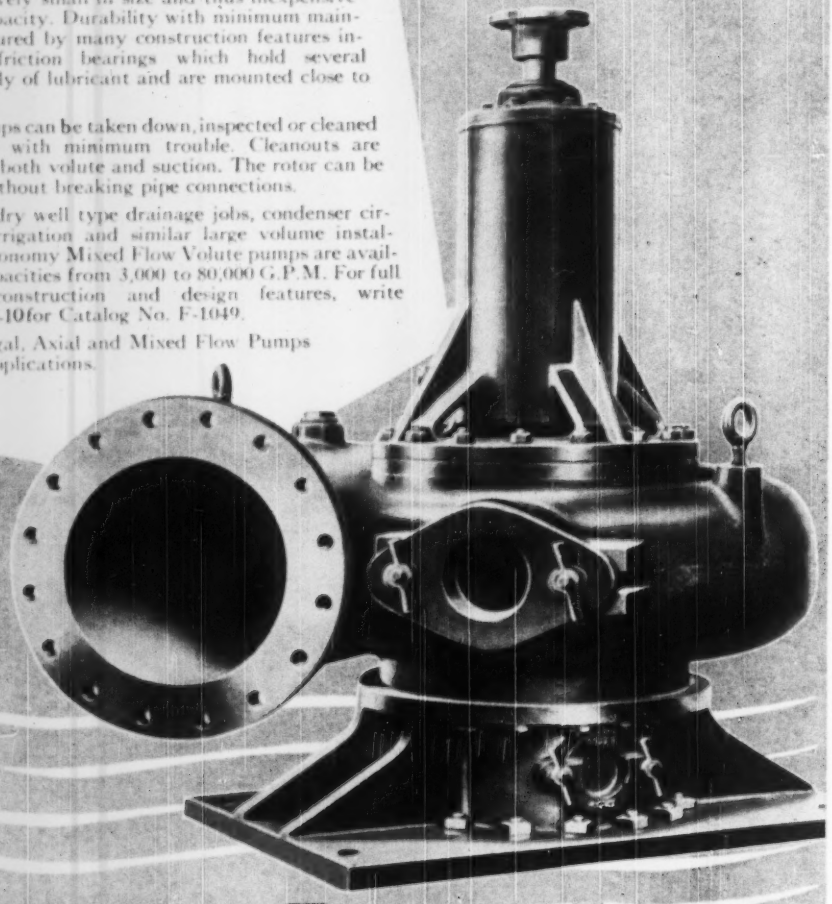
- 115 m.g.d. of sewage flow
- 3 acre inches a minute of irrigation or drainage water
- 80,000 gallons of raw water a minute

The Economy-Mixed Flow Volute Pump is designed for service where large volumes of liquids without heavy solids are to be handled. A high speed pump, it is comparatively small in size and thus inexpensive for its high capacity. Durability with minimum maintenance is assured by many construction features including anti-friction bearings which hold several months' supply of lubricant and are mounted close to the impeller.

These pumps can be taken down, inspected or cleaned quickly and with minimum trouble. Cleanouts are provided in both volute and suction. The rotor can be removed without breaking pipe connections.

Used in dry well type drainage jobs, condenser circulation, irrigation and similar large volume installations, Economy Mixed Flow Volute pumps are available in capacities from 3,000 to 80,000 G.P.M. For full details, construction and design features, write Dept. BK-10 for Catalog No. F-1049.

Centrifugal, Axial and Mixed Flow Pumps for all applications.



Economy Pumps Inc.

DIVISION OF HAMILTON-THOMAS CORP., HAMILTON, OHIO

Lithographed on stone by Edward A. Wilson

U.S. PIPE

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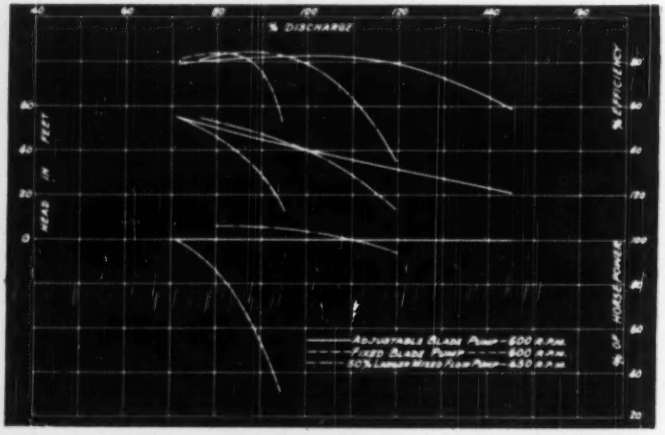

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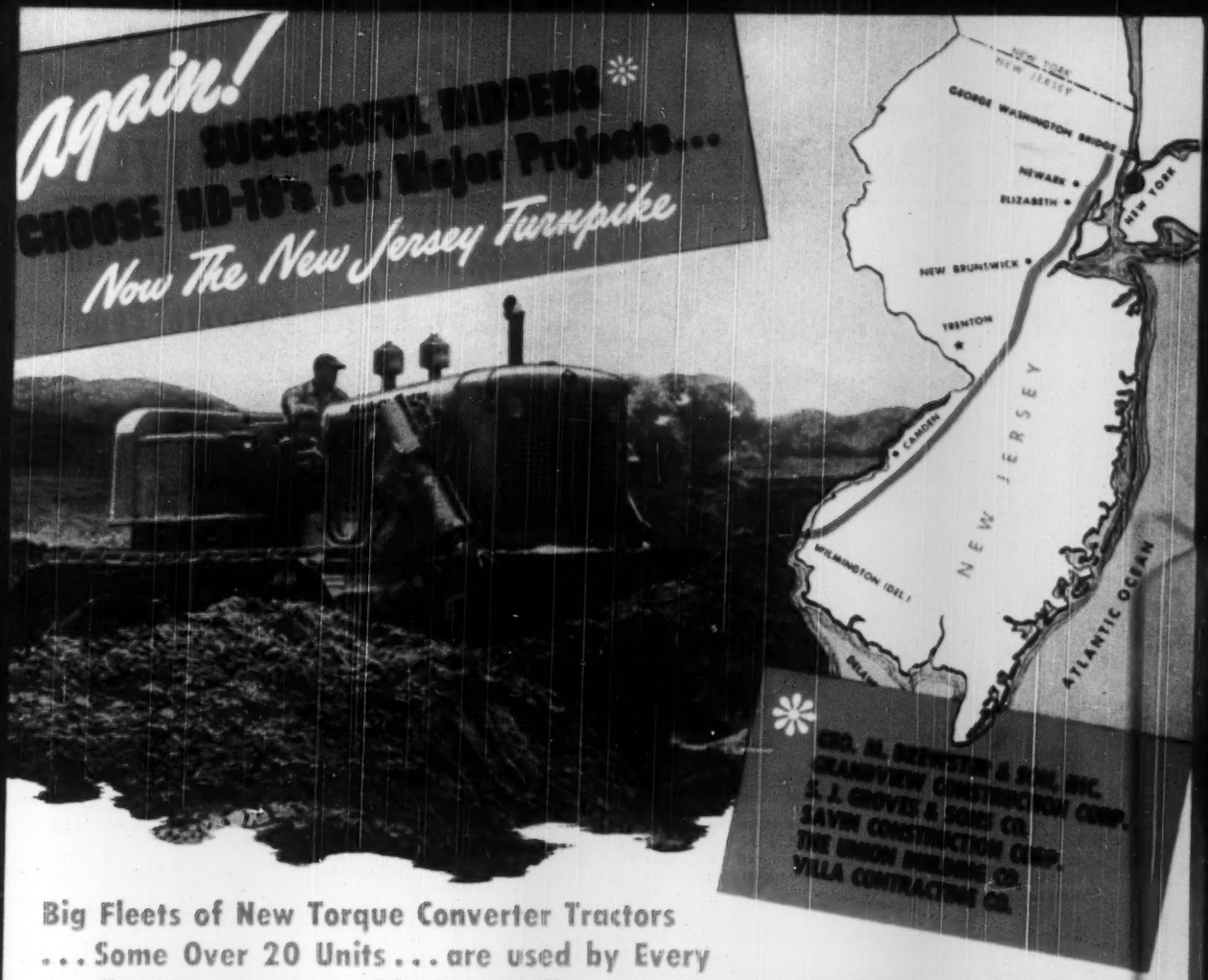

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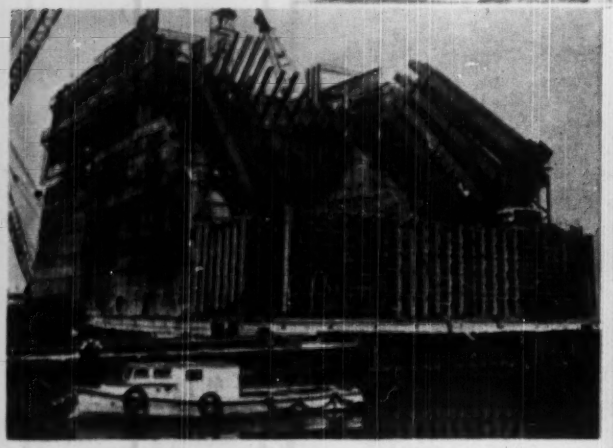
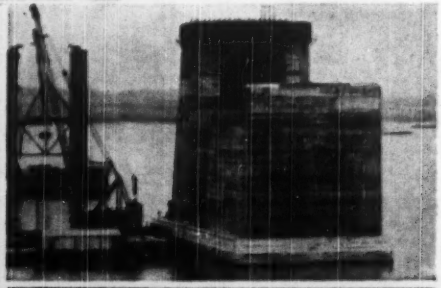
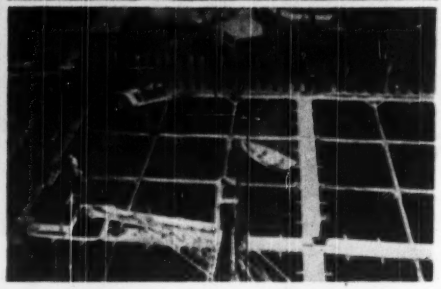
CROSSING THE DELAWARE--1950 STYLE

Substructure Concreting on Delaware Memorial Bridge, Spectacular Construction Achievement, Highlighted by Record Concrete Pour







The east anchorage pier of Delaware Memorial Bridge is a huge monolith rising 158 ft. above the river. Concreting the foundation slab, a solid half-acre of concrete, 32 ft. thick, involved a record tremie pour—two floating mix plants supplied 26,888 cu. yds. of concrete, placed under water in 7.4 days' continuous operation.

● Spectacular in eye-pleasing grandeur, the Delaware Memorial Bridge, sixth longest of its type, with 2150-ft. clear center span, will connect Delaware's duPont Highway with New Jersey's great, new Turnpike.

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The east anchorage pier is of cofferdam construction, and here this dramatic project reached its climax. The massive foundation slab, 99 ft. wide, 225 ft. long and 32 ft. deep, involved a record non-stop pour of 26,888 cu. yds. of concrete, placed under water by tremie method in 7.4 days.

Building the bottom of a bridge across a busy river in all kinds of weather takes specialized skills, precision planning, adequate equipment, and above all, clocklike co-ordination—with an assist from suppliers who can be depended upon to mesh their operations with yours.

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OCTOBER 1950
VOLUME 20 NUMBER 10

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LINK-BELT
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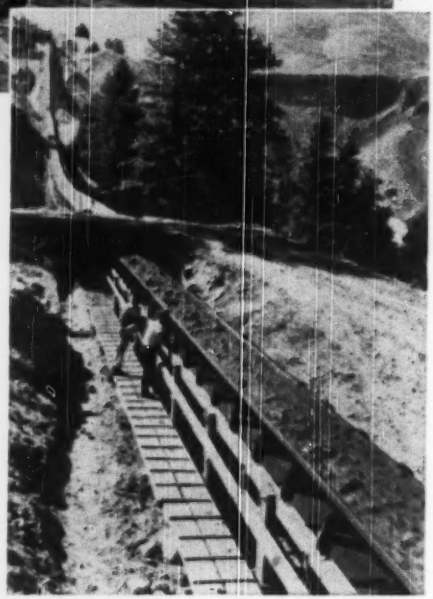

Close-up view of Link-Belt belt conveyor system carrying fill 8,000 feet from borrow pit to Anderson Ranch Dam on Boise River, Idaho.

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FIG. 1. CONSTRUCTION OF NEW RUNWAY 7,000 ft long and 200 ft wide was divided into phases to allow uninterrupted traffic to Frankfurt Terminal Building. West warm-up apron was aligned in direction of future NE-SW runway.

Airlift Airfield Gets Heavy Concrete Runway

Construction Combining U.S. and German Methods Increases Air Traffic Capacity at Western End of Berlin Airlift

WILLARD C. JENSEN, Jun. M. ASCE

Major, USAF; Directorate of Installations, Headquarters USAFE; Formerly Soil and Material Testing Officer, 862d Engineer Aviation Battalion, Germany

THE BERLIN AIRLIFT, 1948-1949, demanded aircraft having dual wheel loads from 37,000 to 70,000 lb. As the original runway of the Rhein-Main Air Base was designed for a single wheel load of 15,000 lb, it was necessary either to reinforce this runway or to build a new one capable of sustaining heavier aircraft. Obviously, any interruption of Operation Vittles was impracticable, so the new runway project (Fig. 1, above) was approved March 29, 1949. This project called for a combination of American and German methods so as to arrive at the most feasible construction procedures for the conditions encountered.

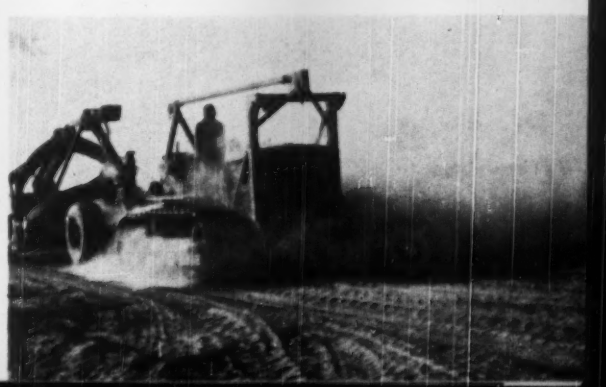
In the summer and fall of 1948, soil and load bearing tests were made for the new runway location by C. R. Foster, Assoc. M. ASCE, Assistant Chief of the Flexible Pavement Branch, Waterways Experiment Station, Corps of Engineers, Vicksburg, Miss. His investigation revealed the presence of two types of friable soils: (1) a fine brown sand (Corps of Engineers classification SF) just under the top soil for an average depth of 3 ft; and (2) a white to yellow gravelly sand classified as SW, under the SF soil for a depth of 30 to 40 ft to the groundwater table. The SF soil was slightly cohesive, with 8 to 10 percent passing a 200 sieve, while the SW soil was non-plastic, with 2 to 3 percent passing this sieve.

Modified AASHO densities were 128 lb per cu ft for the SF soil and 123 lb per cu ft for the SW soil. The subgrade modulus for both soils was 300 psi per in. when compacted to 95-percent Modified AASHO density. Neither a loaded 12-cu yd Turnapull nor a U.S. Army D-8 tractor produced the compaction-in-place density required. A 100-percent Modified AASHO density was necessary 24 in. below the pavement surface and a 95-percent density at a 36-in. depth.

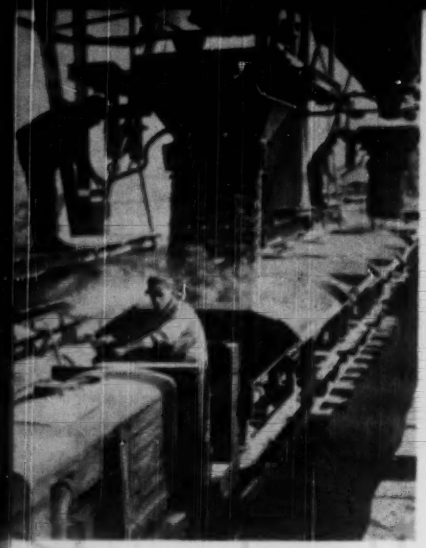
Since limited American engineer troops and equipment were available, it was realized that removal of soil and its replacement with the necessary compaction would require considerable time. Following an unsuccessful effort to obtain a Proctor super-compaction roller from the United States, a change in the design subgrade modulus was decided on; that is, 100 instead of 300 psi per in. was chosen to allow for unexpected weaknesses of the subgrade. Coupled with the compaction problem was the gross aircraft load of 170,000 lb specified by Headquarters, USAFE. No approved method was known for evaluating the effect of multiple wheels, so the design was based on a single wheel load of 85,000 lb. A minimum flexure strength of 600 psi was considered reasonable.

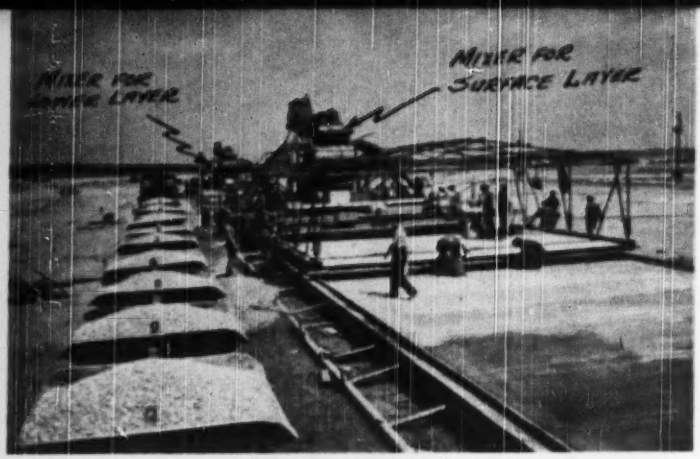
Utilizing the empirical design curve from the Engineer Manual for War Department Construction (*Airfield Pavement Design*, July 1946), with a K = 100 psi per in. and a flexure strength of 600 psi, a wheel load of 85,000 lb required a 17-in. depth of concrete for the center section of the runway and a 21-in. depth for taxiways, aprons, and a 950-ft length at each end of the runway (Fig. 2). The runway would be 7,000 ft long and 200 ft wide. The general direction was established as parallel to the existing runway, whose direction was such that for about 95 percent of the time the beam wind component did not exceed 13 miles per hour. The glide angle and lateral clearance required by Air Force and International Civil Aeronautical regulations could not be complied with entirely and were waived by Headquarters, USAFE.

The project was assigned to the Commanding Officer, 862nd Engineer Aviation Battalion, to be jointly financed by USAFE and the Verkehrs-Aktiengesellschaft Rhein-Main (Traffic Company Ltd., Rhein-Main Airfield). The Air Force share of expenses was 2,500,000 DM (Deutsche Marks) or about $750,750. It was originally intended that the USAFE would pay only for labor and equipment rental but the contractor's bid was so low that the Air Force had to



TRACTOR-SCRAPER of 12-cu yd capacity was outstanding machine for preparation of pavement subgrade. See Fig. 3. In August 1949 men worked under handicap of high winds which caused dust blackout. Majority of soil was SF classification, without appreciable binder.





INDUSTRIAL RAIL SYSTEM transported dry-batched aggregate for concrete airfield pavement. Cars, each carrying sufficient aggregate for 1 cu meter of concrete, were loaded at batching plant (left and bottom of page). At first pavement was poured in two lifts (above) but after August 22, 1949, it was poured in one operation (top of opposite page). Wooden forms were used, as steel forms for 17-, 21-, and 28-in. heights were not available.

TABLE I. COMPOSITION OF TRIAL MIXES FOR AIRFIELD PAVEMENT
Second Mix Was Used for Bulk of Pavement

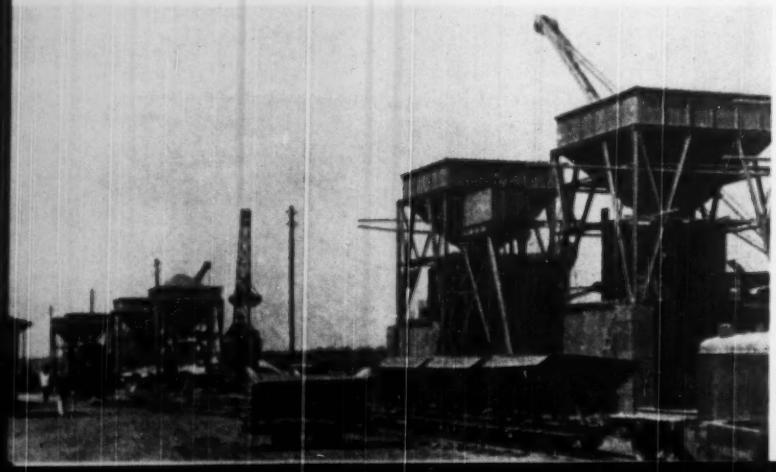
Items	First Trial Mix		Second Trial Mix	
	Lb per Cu Yd	Kg per m³	Lb per Cu Yd	Kg per m³
Sand, 0 to 3 mm (0 to 0.1 in.)	1,121	666	993	590
Gravel, 3 to 30 mm (0.1 to 2 in.)	1,155	686	1,296	770
Splitts (crushed stone), 7 to 15 mm (¼ to ⅝ in.)	246	146	276	164
Splitts, 15 to 30 mm (⅝ to 2 in.)	872	518	981	583
Cement (Dyckerhoff Z 225)	528	314	589	350
Admixture (Plastiment)	3.16	1.88	3.57	2.12
Water cement ratio				
As designed	6 gal per U.S. sack		5 gal per U.S. sack	
As actually poured	4.2 gal per U.S. sack		4.13 gal per U.S. sack	
Water actually added	85 to 90 liters per m³ (17.6 to 18.6 gal per cu yd)		112 liters per m³ (23.1 gal per cu yd)	
Consistency desired	1-in. slump		1-in. slump	

lay out 1,644,148 DM for concrete materials in order to expend its monetary share of the project. Besides this monetary outlay, the Air Force was completely responsible for preparing the subgrade, drainage, shoulders, and overruns. The Verkehrs-AG was committed to allocate a maximum of 3,500,000 DM to procure construction materials.

The important sections of the "Special Contract Conditions" were: (1) The project was to be a fixed unit price contract. (2) No claims for reimbursement could be made if by the contractor's fault or because of bad weather the work was made more difficult, delayed or interrupted, or if the contractor had to carry it out in some other way. (3) The employer reserved the right in the case of any alternate or additional item to determine the type of work, to agree on an adequate unit price, and then to order the performance of the work. (4) No claims for reimbursement could be made if the bid was canceled.

Prospective bidders were informed further that: the construction of a dry batch plant would be required; the employer would provide railroad facilities to the batch plant; hauling of dry-batch material would be accomplished by about 55 U.S. Army trucks; and the time limit for completion of concrete work, including joints, would be four months and if this time limit was exceeded for reasons which were the contractor's responsibility, a fine of 1,000 DM for each additional day would be charged. Further, any change in the quantities mentioned in the bid of more than 10 percent during the construction time would be followed by an increase or decrease in the unit price. Construction was to be performed under American supervision. Tests would be in an American laboratory and would be in accordance with military procedures and standards and/or the regulations and specifications for the Reichsautobahn, the German national highways.

As for the concrete pavement, (Table I), the following facts were to be considered: A minimum daily output of 1,137 cu yd (870 m³) would be required to pour approximately 113,700 cu yd (87,000 m³) of concrete. The cement factor would be about 589.1 lb per cu yd (350 kg per m³) (Portland Cement Z-225) with 0.6 percent by weight as an admixture

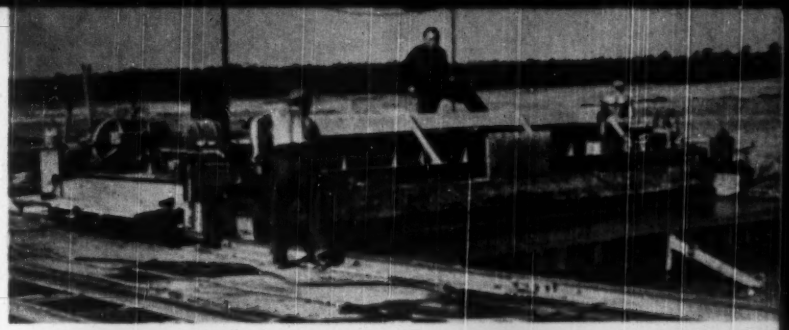


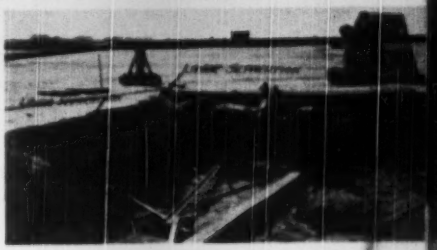
DRY-BATCHING PLANT consisted of ten hoppers—three for cement and seven for aggregate (three for crushed stone, two for gravel, and two for sand sizes 0 to 3 mm). Cement hoppers had electrically controlled batch proportioners and aggregate hoppers had weight boxes with balanced beam scales for control of proportions.

TABLE II. ITEMIZED CONTRACTOR'S COSTS ON AIR BASE AS OF DECEMBER 1, 1949

(Approximately 3.33 Deutsche Marks = 1 U.S. dollar)

Item	Deutsche Marks	Dollars
Establishing batch plant	53,875	16,163
Operating batch plant	195,371	58,611
Removing batch plant	21,896	6,569
Water line, mixing and curing concrete	10,703	3,211
Water line, additional lines for military	4,595	1,379
Electrical job site construction	5,871	1,761
Other job-site construction, offices, etc	54,867	16,460
Sand leveling course	41,280	12,384
Oil-paper course	44,720	13,416
Concrete, mixing, placing	3,436,500	1,030,950
Expansion joints	23,433	7,030
Dummy joints	8,320	2,496
Dummy joints with dowels	1,222	367
Construction joints (longitudinal)	1,800	540
Painting of longitudinal joints with Inertol	26,200	7,860
Industrial rail costs	217,500	65,250
Drivers' hourly wages	32,480	9,744
Extras, day labor	11,050	3,315
	4,191,683	$1,257,506





POURING CONCRETE IN ONE LIFT (above) eliminated early difficulty of layer separation (right) experienced when concrete was poured in two lifts. Concrete was consolidated by high-frequency internal vibrators and finished by German autobahn high-frequency surface vibrating and finishing machines. Pavement section seen at right was removed by contractor because of construction errors, which included placement of upper layer over lower layer after latter had taken final set and been covered by dust blown by high winds.

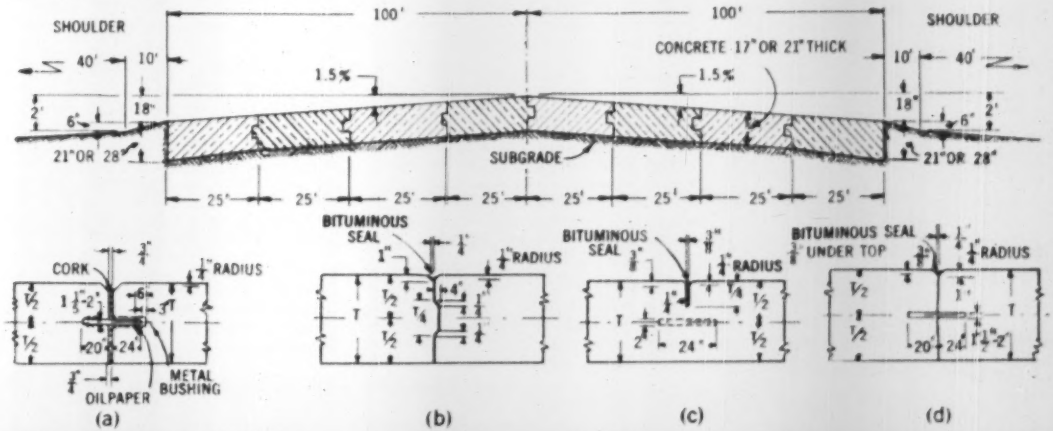
utilizing Plastiment or equal material. Approximate mixing proportions would be 1:2:3 (50 percent gravel and 50 percent crushed stone). Aggregates would be washed and sieved in accordance with the military prescribed curve, which is similar to gradations prescribed by ASTM specifications. A minimum compression strength of 4,975 psi (350 kg per cm^2) and a minimum flexure strength of 683 psi (48 kg per cm^2) must be obtained. Job-site curing was to be for a minimum of 14 days wet, using tarpaulin or jute cover.

There were 39 bids submitted, ranging from 3,804,475 to 8,160,597 DM. The over-all average was 5,300,000 DM with twenty contractors falling below this average. The contract was awarded to the firm Dipl. Ing. R. Koegel, Frankfurt am Main, whose bid totaled 4,227,440 DM (later reduced to 4,196,503 DM by utilizing industrial rail cars instead of 55 military trucks for dry-batch hauling). Four lower bids were submitted but were rejected because of improper gradation and quality of aggregates or improper methods of fabrication and placement. Table II gives a breakdown of the contractor's total costs. The winning bidder's estimate for labor was only about a third of that in the average bid because the firm had modern autobahn equipment.

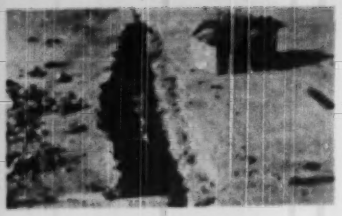
Work on the new runway began with a ground breaking ceremony April 28, 1949. During the first 60 days, the contractor completed his batch plant and job-site installations and the military completed topsoil stripping for the entire runway, as well as final compaction of the runway section for construction Phase I (Fig. 1).

The initial subgrade work was very slow as construction Phase I required removal of an additional 12 in. of soil from the field and its replacement with borrow from a pit which had excellent binder of SW classification.

FIG. 2. TYPICAL CROSS SECTION of new runway (below, top) at Rhein-Main Airfield has construction joints 25 ft apart. On center runway section, pavement thickness is 17 in., increased to 21 in. at outside edges. On taxiways, aprons, and 950-ft length at each end of runway, pavement is 21 in. thick with edges 28 in. thick. CROSS SECTIONS THROUGH JOINTS (below) show: (*a*) Expansion joints, spaced at 300 ft, with moveable end of dowel shown at right. This end was roughened, painted, greased and surrounded with oil paper between concrete and ¾-in. premolded expansion joint material (bituminous treated cork). (*b*) Longitudinal construction joints spaced at 25 ft. (*c*) Dummy groove joints, spaced at 20 ft both with and without dowels. Dowels, used at ends, are of extra strong, 2-in.-dia pipe, 24 in. long, spaced 18 in. apart. (*d*) Transverse construction joints in line of dummy groove joints, 20 ft apart. Expansion joints between west warm-up apron and runway were constructed without dowels, which were considered unnecessary because edges of both apron and runway were thickened to 28 in.



EARLY DIFFICULTIES with dummy joint construction were solved by setting template into fresh concrete by vibrating apparatus shown at left. Original procedure of digging out finished surface or manually driving template resulted in joints with loose and hollow sides, which later had to be dug out (lower left) and repoured.



Compaction by sheepsfoot wobble-wheel rollers, four-ton trucks and the loaded soil-testing trailer resulted in a firmly stabilized subgrade. A monthly record of equipment used for earthwork is shown in Fig. 3. To accelerate the earthwork for construction Phase 2, only 8 in. were removed and replaced with a mixture of the SF soil with little binder and topsoil minus roots or vegetation. Phases 3 and 4 subgrade preparation, utilizing the same procedures as Phase 2, were completed by the end of September. In the last three months, grading of shoulders and overrun stabilization were completed.

Construction soil tests revealed that the 100-percent modified AASHO densities for the SF and SW soil varied directly with the percentage of fines smaller than U.S. standard No. 200 sieve. A curve was plotted which indicated that densities varied from approximately 114 lb per cu ft for 2-percent fines to 130 lb per cu ft for 15-percent fines. To control subgrade preparation, 28 plate bearing and allied soil tests were made. The over-all average test values were:

Location	Density by % Modified AASHO	
	Desired	Actual
24 in. below pavement surface	95* 100	97
36 in. below pavement surface	90* 95	95
More than 36 in. below pavement surface	90	93

* Allowable reduction for sands with cohesion

The subgrade modulus desired was 100 psi, whereas an actual strength of 250 psi was obtained. By the California Bearing Test the desired ratio was 6, and that actually obtained was 26. Moduli values ranging from 220 to 530 psi per in. were the result of the compaction procedures involving the 12-in. cut and compacted refill with a SW soil having an excellent binder. When this procedure was revised to the 8-in. cut and refill, a reduction in subgrade moduli was obtained for construction Phase 2, in which the *K* values averaged 115 psi per in. The accelerated construction required for Phase 2 and the loosely compacted 4-in. SF blanket which was placed on the subgrade surface for frost protection caused the lower subgrade moduli.

The SF-topsoil mixture underlying the frost blanket had densities averaging 95 percent modified AASHO. Phase 3 and 4 subgrade moduli were higher, ranging from 200 to 300 psi per in. because the SF-topsoil mixture was used for the compacted refill without the SF frost blanket. The pavement thickness was 17 in. or greater, and oil paper was placed between the concrete and the ground. The groundwater table was 30 to 40 ft deep and the Corps of Engineers frost index for Rhein-Main was less than 400. Thus when considering all these three frost-heave factors, adequate frost-heave protection was provided for the fine SF topsoil mixture having 10 to 15 percent passing a U.S. standard No. 200 sieve.

Next came the concrete work. It was decided in conferences with the contractor that Plastiment would be used for the entire pavement thickness; that asphalt impregnated celetex plates would be used for expansion joints as the contractor recommended; that the military would furnish a joint filler; and that industrial rail cars would be utilized instead of the 55 military trucks originally planned.

By June 30, 1949, the contractor was ready to pour concrete. The runway initially was poured in two lifts because standard autobahn equipment was used. This equipment was designed to consolidate a very dry concrete for roads, 6 to 8 in. thick. Since common practice in autobahn construction was to pour the pavement in two lifts, the contractor proposed to pour the lower 8 in. of the runway with one set of machines and the upper or surface layer with a second set of machines. For autobahn construction, German engineers had so emphatically stressed the value of a low water-cement ratio, that most German road-building firms had gone to the extreme of placing concrete so dry that it resembled moistened earth, with no slump possible by ASTM standards.

Before convincing the Germans that such a dry concrete was not good for *startbahn* (runway) construction, for one week the first trial mix was poured using only about 4.2 gal of water per sack of cement, instead of the 6 gal for which the mix was designed. As had been foreseen, the result was unsatisfactory workability and honeycombed concrete in large areas. A new mix with a lower water-cement ratio was then designed having a 1-in. slump by ASTM specifications. This second mix (Table I) proved satisfactory and was used for the rest of the concrete.

Both trial mixes utilized the procedures recommended by the Portland Cement Association. Although

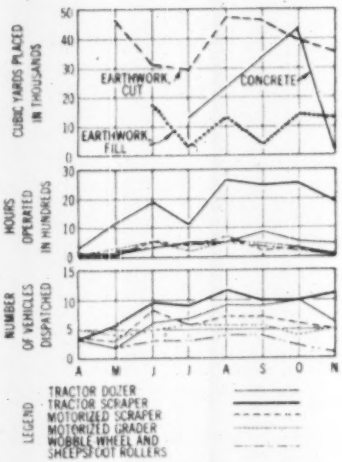


FIG. 3. VOLUMES of earthwork handled and of concrete placed in months of 1949 are shown in top graph. After August 15, contractor used two 11-hour shifts to increase concrete placement so as to complete pouring by Nov. 1. Lower graphs show use of five types of earthmoving equipment, by hours operated and by number of vehicles. Obviously, tractor scrapers were workhorses for subgrade preparation. Lack of spare parts placed heavy work load on 2nd and 3rd echelon shops.

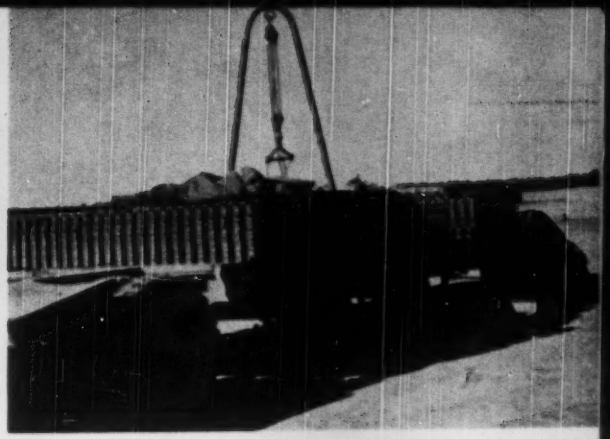


PLATE BEARING TEST apparatus was mounted on heavy equipment trailer. Seating load of 1 psi was placed initially on 30-in.-dia plate (above). This load was released and load of 10 psi maintained until extensometers no longer indicated plate settlement. Pierced steel planks on trailer (right) supplied required loadings, and Rodgers Universal hydraulic press was used to apply leaving plate loading.

the second trial mix was designed for 5 gal water per sack, the Plastiment admixture permitted a reduction of about 15 percent in the water cement ratio while still maintaining the desired consistency. In the first trial mix, the water content was reduced about 30 percent, giving a harsh mixture although Plastiment was also used in this mix.

Although a satisfactory concrete mix was thus established after the first week, placing and curing procedures were substandard and a concrete in accordance with specifications was not being obtained. The concrete forms, which also carried the mixing and placing machines, were settling and losing alignment because of machine vibrations. The horizontal misalignment was corrected by utilizing more side bracing, and elevations were maintained by resetting forms after the first layer had been poured. Honeycombed areas near the forms were eliminated by using high-frequency internal vibrators. The first very dry mix presented difficulties in obtaining a satisfactory surface, as the aggregate was still exposed after surface vibration. Such areas had to be capped with a cement mortar.

This condition was improved when the second trial mix of 5 gal per sack was used, permitting the aggregate to settle and the cement paste to rise for proper surfacing. After August 22, 1949, the placement procedure was changed and the concrete was poured in one layer. This method was made possible by bringing more internal high-frequency vibrators on the job. By pouring the concrete in one lift, two sets of machines were released, and the contractor was able to pour four lanes simultaneously. A fifth lane was added in September when another set of machines was brought on the job.

The military had considerable difficulty in obtaining a 14-day wet curing period. By the middle of September, pouring had accelerated to the point where the contractor had insufficient means of curing in accordance with specifications. Motorized water sprinklers and stationary sprinkling systems were utilized but were inadequate for the area involved, and some pavement sections were allowed to become too dry during the initial curing period. The contractor was fined 100 DM per day when any of the areas was not properly cured.

Dummy-joint construction methods were not satisfactorily solved until the latter part of September. The original procedure of digging out the finished surface or manually driving the joint template into the surface of the concrete resulted in a joint with loose and hollow sides, which later required considerable repair work. Vibrating the template in place gave a satisfactory dummy joint. Although these construction difficulties indicate that there were times when the workmanship did not meet the approval of the military, the contractor's accomplishment of pouring 114,458 cu yd (87,573 m^3) of concrete in 125 days can be considered exceedingly commendable.

Adequate supervision by constant field inspection and laboratory testing resulted in a concrete having sufficient strength and durability for design specifications. A total of 150 test specimens were poured. Of these, 89 were flexure test beams with an average modulus of rupture of 699 psi (49.1 kg per cm^2) at 28 days. The compression test specimens were broken after 7 days because the prefabricated strength testing apparatus had insufficient capacity for the 28-day compression tests. Of the 61 compression tests, an average of 4,770 psi (336 kg per cm^2) was obtained when using American standard cylindrical specimens and assuming that specimens 7 days old have 70 percent of their 28-day strength. The Germans tested 106 cube specimens and obtained an average strength of 6,790 psi (477 kg per cm^2). The German method of testing gives approximately 30 percent more strength

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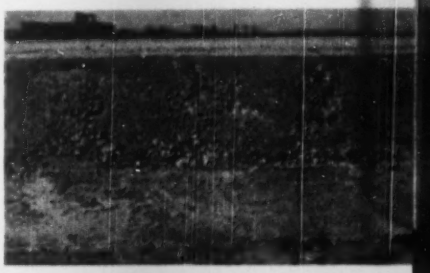

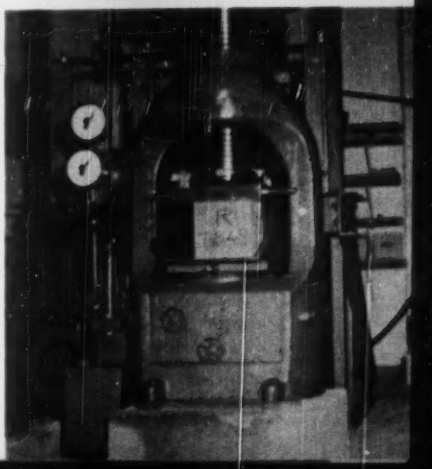

HONEYCOMBED CONCRETE (upper right) was caused by reduced water cement ratio initially used by contractor in accordance with practice on German autobahn. Section shown was poured with approximately 4.2 gal per sack, although designed for 6 gal per sack. Compression tests on concrete specimens were made by German method (lower right) which gives greater strength than ASTM method because: (1) specimen tested is cube with height-to-width ratio of 1:1 instead of 2:1 in ASTM method, giving about 13 percent more strength; and (2) specimens are tested in air-dried rather than moist condition, which also increases strength 20 to 30 percent.

TWO-SPAN CONCRETE girder bridge carrying U.S. 41 over Prairie Creek near Sterling, Ind., collapsed when pier was undermined in a 1946 flood. Bridge was built in 1924, before revisions in field survey practice and before establishment (in 1925) of general practice of using piling under footings founded on erodable material, even though material has adequate bearing value.

Bridge Waterway Area Formula Developed for Indiana

ROBERT B. YULE, M. ASCE

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AS FAR BACK as 1927, the Indiana State Highway Department began the collection and study of field data for use in determining the waterway areas of all new bridges. The author was responsible for the initiation and conduct of this study.

The study included the determination of drainage areas; measurement of waterway areas of existing bridges, including flood flows over approaches; taking of low- and high-water elevations; examination of evidences of bed scouring and undercutting of bridge foundations; and evaluation of the testimony of local residents as to the adequacy of the waterway areas of bridges. Descriptive notes were taken on the shape of the drainage areas, character of topography, type of soil, and land use.

In Indiana, the annual rainfall varies from 35 in. in the northern part of the state to 45 in. in the southern part. The greatest general flood of record in the larger streams occurred in 1913, the same storm that caused the "Dayton Flood" on the Big Miami River in Ohio. In four days 11 in. of rain fell and the runoff was nearly 100 percent. Other general storms causing river stages nearly as great occurred in 1875, 1897, and 1927. These might be called the "once-in-17-year floods" or the "6-percent chance storm." Bridge waterway area requirements obtained from these floods were generally made the basis for determining the waterway areas of new bridges. Over a period of 12 years following the institution of this policy of careful waterway area studies as the basis for bridge design, only one stream crossing suffered major damage from a flood.

Records of the data obtained in surveys for new bridges over a period of six years resulted in 340 recordings which were usable in seeking a simple waterway formula. Conventional waterway area formulas now in use are based on certain geographical areas and ranges in the size of drainage areas to which they are applicable, the limits of applicability being the range of data which the originator of the formula had available.

Variations in Indiana Topography Considered

The northern three-fifths of the state of Indiana is flat to heavily rolling and covered with glacial drift to varying depths. In a few places bed rock is near enough to the surface to alter the typical glacial-drift topography and has affected the rate at which some of the streams are cutting down. The southern two-fifths of the state can be classed as rolling to very hilly. Parts of this area are glaciated and the topography is much affected by the Wabash River. The remainder of the area is rolling to very hilly, and bed rock everywhere influences the topography. A distinctive feature of a central north-and-south strip about 50 miles long and 25 miles wide is sink-hole and subterranean drainage.

Since topography of the drainage area usually has more influence than any other factor affecting runoff, Indiana's drainage areas were grouped under three classifications—flat, rolling, and hilly.

Data of waterway area, A, in square feet, were plotted against drainage area, a, in square miles to logarithmic scale. After some study it was found that lines following the equation,

$$A = Ca^{2/3} \quad . \quad . \quad . \quad . \quad (1)$$

were nearly the medians of each group of data. Upper and lower limits for each group were established by assigning values of C, and the resulting plottings are shown in Fig. 1. Suggested values for this general coefficient C in Eq. 1, for Indiana conditions, are as follows:

1. Flat . . . $C = 0.3$ to 0.7
2. Rolling . . $C = 0.7$ to 1.3
3. Hilly . . . $C = 1.3$ to 2.2

Several other of the simple formulas were compared by drawing the lines representing their limits. All the formulas give approximately the same results for small drainage areas. The Meyer formula and Dun's table give waterway areas that are much too

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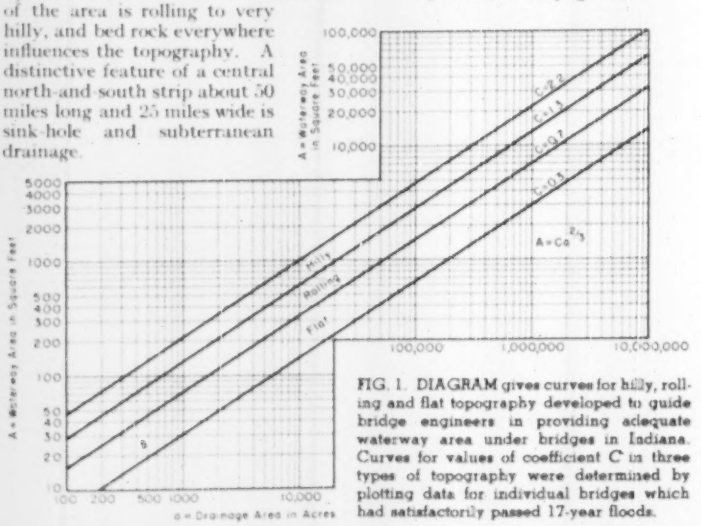


FIG. 1. DIAGRAM gives curves for hilly, rolling and flat topography developed to guide bridge engineers in providing adequate waterway area under bridges in Indiana. Curves for values of coefficient C in three types of topography were determined by plotting data for individual bridges which had satisfactorily passed 17-year floods.

Southern Railway Crosses Cumberland River 270 Ft Above Stream Bed

New Cantilever Bridge Is Part of Extensive Relocation for Wolf Creek Reservoir

J. B. AKERS, M. ASCE

Chief Engineer, Southern Railway System, Washington, D.C.

CONSTRUCTION of new Cumberland River Bridge was required to raise rail crossing above backwater elevation behind Corps of Engineers' Wolf Creek Dam. New bridge is 108 ft higher than old structure.

TRACKS ON the new double-track Cumberland River Bridge of the Southern Railway at Burnside, Ky., are 108 ft higher above the stream bed than the single track on the bridge it replaces. The increased elevation was made necessary when the Corps of Engineers began its Wolf Creek Dam project, authorized by the Flood Control Act of 1936, "under a coordinated plan for the control of floods and the development of the water resources of the Cumberland River Basin." Waters of the reservoir behind the dam will cover the site of the Southern Railway's old Cumberland River Bridge.

The new bridge is a double-track, deck cantilever structure with two-span continuous anchor arms crossing the river valley at a height of 270 ft above the stream bed. The relocation begins at a point on the existing double-track line north of the river and crosses the river at a point about 1,425 ft upstream from (east of) the old bridge, to connect with the existing single-track line near Tateville, Ky. The new double track extends an actual distance of 4.12 miles, of which 0.58 miles was existing double track reconstructed in the relocation. The additional double track therefore amounted to 3.54 net miles. The project also required the construction of 2.75 miles of team and industry tracks to replace similar facilities to be inundated by the backwaters of the Wolf Creek Dam.

The District Engineer, Nashville District, Corps of Engineers, U. S. Army, under whose direction the Wolf Creek Dam and Reservoir Project is being carried out, required that the new bridge over the Cumberland River have sufficient clearance above high water to provide for future navigation. This requirement resulted in raising the elevation of the tracks on the new bridge 108 ft above those on the old bridge.

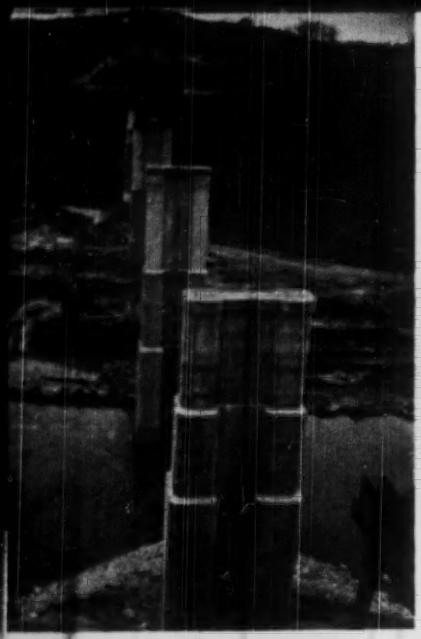
The relocation (Fig. 1) resulted in the elimination of a sag at the old bridge, which had ascending grades of 1.14 percent on both ends. Two tunnels were also eliminated, one with a length of 1,076 ft on a 6-deg curve and another, 1,165 ft on a 4-deg curve. The result was a saving of 755 ft in distance, and the elimination of 150 deg 30 min of central angle. Grades were reduced from a maximum of 1.14 percent uncompensated on the old line, to maximum compensated grades of 1.00 percent northbound and 0.80 percent southbound on the new location. Maximum curvature of 6 deg on the old line was reduced to 5 deg on the new line, and 59 ft of rise and fall were eliminated.

The new bridge was designed by Modjeski and Masters, Harrisburg, Pa., in accordance with the provisions of the 1945 American Railway Engineering Association Specifications for Cooper's E-72 loading. It is a double-track, deck cantilever structure with two-span continuous anchor arms (Fig. 2). From north to south, it is made up of a 229-ft 6-in. span and a 255-ft 0-in. span forming a continuous anchor arm with the fixed point at the pier between these two spans; a 76-ft 6-in. cantilever arm; a 153-ft 0-in. suspended span, a 76-ft 6-in. cantilever arm; a 225-ft 0-in. span and a 229-ft 6-in. span forming a continuous anchor arm with the fixed point at the pier between these two spans; and an 82-ft 0-in. plate girder span. Total length of cantilevers and suspended span is 306 ft 0 in., and total length of the bridge is 1,359 ft 6 in. center to center of abutment bearing.

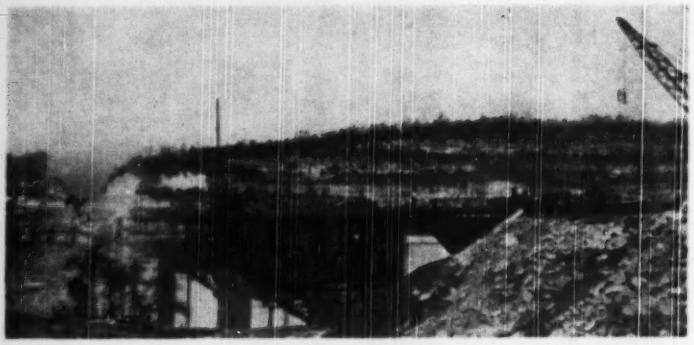
The Warren-type trusses are 50 ft deep over the fixed piers and 46 ft deep over the expansion piers. The suspended span is 36 ft deep and the anchor-arm spans are 40 ft deep.

Piers and abutments, of reinforced concrete, are founded on rock. The piers were designed as stepped prisms rather than with tapering sides to permit the use of sliding forms, which resulted in considerable economy.

BRIDGE APPROACH through north bank of Cumberland River has walls benched because of shattered rock conditions. Benching on right (west) wall is complete.



BRIDGE PIERS are step-tapered to permit use of slip forms. Contractor had one batching plant in operation for nearby highway bridge, and erected another on river flats. Concrete was placed in forms by Pumpcrete methods, cranes and buckets, and by steel tower with hoisting equipment.



ANCHOR ARM is erected out from south embankment on falsework bents. Far half of anchor arm was cantilevered out from Pier IV to Pier III. Cantilevered truss and half of suspended truss were also erected from south end.

The structure provides a clearance of 46.8 ft above the crest gates of the Wolf Creek Dam. The top of ties is 260 ft above average water level prior to construction of the dam, about 270 ft above the stream bed, and 87 ft above the top of the crest gates. The tallest pier is 217 ft from rock foundation to top of coping. There will be about 185 ft of water under the bridge at the highest pool level.

Silicon steel was used throughout the trusses with the exception of verticals. Handrails are provided for the full length of the bridge on both sides of the deck. An inspection walk extends under the deck for the full length of the truss spans. Conley rail joints are used at the expansion end of the suspended span. The bridge ties are secured against longitudinal movement by anti-creeper angles at every fourth tie. For three panels on each side of the main piers, and for three panels at the expansion end of the suspended span, every fourth tie was boxed with rail anchors. Tie pads were installed under all tie-plates.

Bids for construction of the Cumberland River Bridge, grading and drainage and miscellaneous facilities in connection with the approaches were opened September 28, 1948. The low bidders were:

Contract No. 1, for the substructure, Massman Construction Co., Kansas City, Mo.

Contract No. 2, for the superstructure, Mt. Vernon Bridge Co., Mt. Vernon, Ohio.

Contract No. 3, for grading, drainage, separation structures, road changes, fencing, etc., Oman Construction Co., Nashville, Tenn., and Moss-Thornton Co., Inc., Leeds, Ala.

All work in connection with tracks, signal installations and related work, and the new depot at Burnside, was performed by railway company forces. Changes in communication lines were made by the Western Union Telegraph Co. under the supervision and direction of the Communications Department of the railway company.

When the contract was awarded for the substructure, the contractor was constructing piers and abutments for a highway bridge over the Cumberland about 600 ft downstream from the proposed railroad bridge. A concrete plant therefore was already in operation on the south bluff and this plant was used on the substructure of the railroad bridge when possible. It consisted of a 27E stationary mixer, a 2-cu yd, three-material batching plant, a cement storage house and a Model-200 Double Rex Pumpcrete machine. The mixer discharged directly into the Pumpcrete bowl. City water was used for mixing and curing. A steam boiler was used on the site of the plant for heating mixing water when necessary. Concrete was forced by the Pumpcrete machine through an 8-in. steel pipe to the delivery points. Where practicable, concrete was delivered directly from the pipe into the forms.

Another concrete plant was erected on the river flats about 100 ft west of Pier III. It consisted of a cement house, batching plant and a 2-cu yd Mixermobile, which is an end-dump mixing drum mounted on a heavy-duty truck. The Mixermobile was equipped with self-powered tower, hoppers, chutes and bucket, and was capable of mixing concrete and depositing it from heights up to 35 ft through its hoppers and chutes. This plant was used for depositing concrete in all places inaccessible to the Pumpcrete plant, and at times when the Pumpcrete was not avail-

FIG. 1. PLAN (left) and PROFILE (below) show section of Southern Railway system from Cedar Grove to Tateville, Ky., which required realignment to raise it above high-water level in Wolf Creek Reservoir. Realignment reduces maximum curves from 6 deg to 5 deg and grades from 1.14 percent uncompensated on old line to 0.80 percent southbound and 1.00 northbound, compensated, on new line. New track crosses Cumberland River 1,425 ft upstream of old crossing.

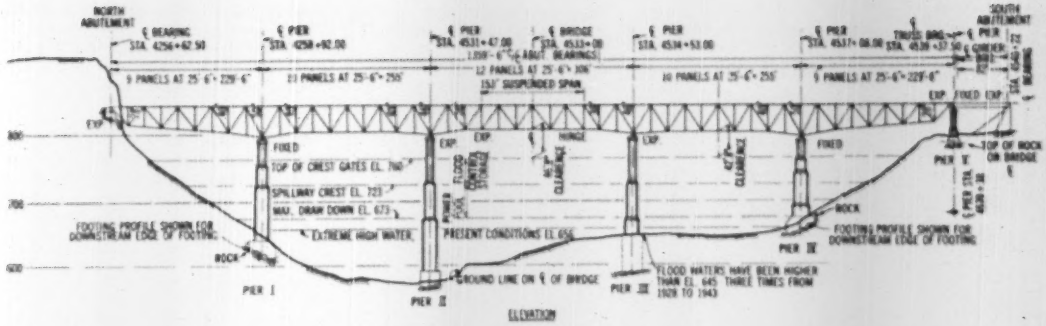


FIG. 2. NEW Cumberland River Bridge, designed for Cooper's E-72 loading, rises about 270 ft above stream bed. Tallest pier is 217 ft from rock foundation to top of coping. All piers are founded on rock.

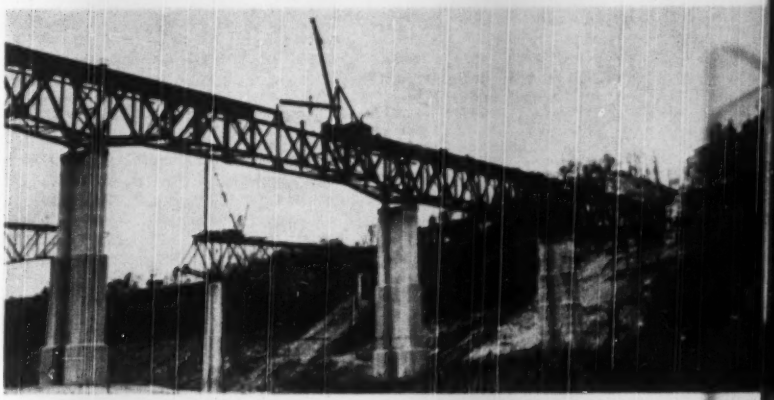
able. When used on the high pier shafts, concrete from the Mixermobile was raised by cranes or by a steel tower with hoisting equipment.

Final quantities for the substructure were: foundation excavation, 14,146 cu yd; concrete, 22,278 cu yd; reinforcing steel, 438,277 lb; structural metal, 75,304 lb.

The Mt. Vernon Bridge Co. started work on the superstructure August 29, 1949, and completed the work September 11, 1950.

The substructure schedule was so arranged that the abutment and piers at the south end were completed first, enabling the bridge company to start erection at that end. After placing the girder span, the first span of the anchor arm was erected out from Pier V on falsework bents to reach Pier IV. The second span of the anchor arm was then cantilevered out to reach Pier III. The cantilever arm was built out from Pier III and half of the suspended span was cantilevered out from the end of the cantilever arm. The work progressed in a similar fashion from the north end. When the north half of the suspended span had been cantilevered out to the center, the two sections were joined together and the suspended span was swung. The actual closure was effected without difficulty April 28, 1950.

The paint used on this bridge complies with special specifications furnished by Modjeski and Masters. The first shop coat consisted of a red-lead iron-oxide pigment in a linseed-oil, synthetic-varnish vehicle. A second shop coat was then applied—of the same material with the addition of black magnetic iron-oxide to produce a color contrast with the first coat. After the steel was erected it was touched up with the shop-coat mix where the paint had been scratched or marred. A coat of aluminum-paste pigment was then applied in a synthetic varnish vehicle (glycerol phthalate type).



FINAL STEEL of suspended span is placed in relocated Cumberland River Railroad Bridge. First coat of paint was red-lead iron oxide in linseed oil and synthetic varnish vehicle. Second coat had black magnetic iron-oxide added for color contrast. Final coat consisted of aluminum-paste pigment in synthetic varnish vehicle. Highway bridge is under construction in background.

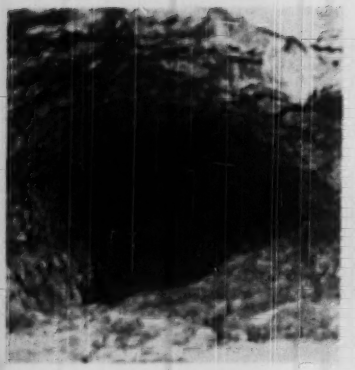
Final quantities incorporated in the superstructure were: structural steel, 7,763,926 lb; creosoted timber deck, 266,314 fbm; bolts and lag screws, 9,945 lb.

Oman Construction Co. and Moss-Thornton Co., Inc., started work on October 13, 1948, and finished on October 22, 1949. Their work was delayed 33 days by labor trouble.

Major items of work involved were: unclassified excavation, 496,555 cu yd (about 90 percent solid rock); overhaul, 2,944,000 station yd; concrete pipe culverts, under tracks, sizes 24 in. to 42 in. with concrete headwalls, 1,890 ft; corrugated metal and highway grade concrete pipe under highways, 420 ft; one 5-ft × 5-ft concrete box culvert; one 4-ft arch culvert with 3-ft sidewalls; one steel and concrete overhead highway bridge; one concrete highway underpass; erection of right-of-way fences, 5.9 miles; and relocation of 0.67 mile of local telephone line.

Excavated material consisted of approximately 90 percent stratified limestone and 10 percent common excavation, which was composed of the large boulders and dirt seams characteristic of the area. The greater part of the excavation came from two large cuts, one through the north bluff, containing 114,500 cu yd, the other through Antioch Gap, south of the city of Burnside, containing 229,500 cu yd. Both of these cuts were in solid limestone and 75 ft deep on the center line. The material in the north cut broke badly, and for safety, additional material was removed from the top of each slope to a depth of about 30 ft for a distance of 14 ft back from the face. Slide-detector fences are being installed.

All cuts were excavated 1 ft below subgrade and backfilled with selected material. The excavated material, because of a swell of 27 percent, resulted in 35,000 cu yd of actual

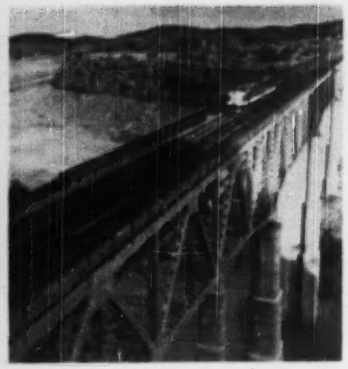


SINK HOLE encountered in excavating southern abutment of bridge was filled with concrete. Larger sink hole found near Tateville drained into underground cave. There catch basin was erected in sink hole to drain into cave through two 24-in. pipes.

waste on the north side of the river. The rest of the excess was deposited in the widening of the embankments and in the approaches to the Elihu Road overhead bridge. The final roadbed in excavation was about 44 ft wide with side slopes in rock of $\frac{1}{4}$ to 1, and of 1 to 1 in common excavation. The specified width of embankments was 33 ft with $1\frac{1}{2}$ to 1 slopes. However, when the excess material was deposited in the embankments, an average width of about 48 ft resulted. Excavated material was deposited in layers, not more than 4 ft in thickness, and was thoroughly compacted by the heavy hauling equipment.

The work also involved grading and drainage for a new depot site, and team and industrial tracks and driveways at Burnside. Grading and drainage for the extension of the passing track, and a team track at Tateville, were also included in this work.

In the course of construction a large sink hole was encountered about 30 ft east of the common center-line of the tracks, in the vicinity of the new depot at Burnside. This sink hole drained naturally into a subterranean channel, or cave, which extends southward beneath the new tracks. The bottom of the hole at the entrance to the cave was about 17 ft below the ground surface, and at the tracks the bed of the cave is about 55 ft below the top of rails. A vertical concrete catch basin 3 ft square and 19 ft high was constructed in the sink hole, with its top inlet at the original ground surface and its invert about 17 ft below the inlet. This catch basin drains into the cave through two lengths of 24-in. concrete pipe. Another sink hole encountered about a half mile north of Tateville had a surface area about 200 ft square and was collapsed by dynamiting and then filled with rock material.



COMPLETED CUMBERLAND RIVER BRIDGE was opened to traffic August 3, 1950. Minimum clearance of 46.8 ft is provided over power and storage pool elevations behind Wolf Creek Dam

The track on the new location was constructed with new 132-RE rail and 6-hole, 36-in. joints. It was fully tie-plated with $7\frac{3}{4}$-in. × 13-in. double-shoulder tie-plates on the grade and $7\frac{3}{4}$-in. × $14\frac{3}{4}$-in. double-shoulder tie-plates on the Cumberland River Bridge. On tangent track, 4 spikes were used per tie-plate, and on curves, 6 spikes per tie-plate. There are 12 rail anchors per 39-ft rail except at each end of the bridge, for a distance of 500 ft, where each rail is anchored at each tie. On the 4- and 5-deg curves, 6 gage rods per 39-ft rail were installed. Spring rail frogs were used on the main tracks. Creosoted oak and gum ties were spaced at 22 in. Ballast consisted of 6 in. of crusher-run limestone subballast and 8 in. of $1\frac{1}{2}$-in. clean crushed limestone.

All subballast was delivered by truck and spread by spreader box operated by the truck. Materials for the northbound main track, the first track laid, were also delivered and distributed by truck. The northbound main track was then laid on the subballast, after which the remainder of the ballast for that track, as well as all other track materials, was delivered and distributed by rail. An Orton crane unloaded and handled the rails and other track materials.

From Tateville to the south end of the Cumberland River Bridge, the northbound track was completed in advance of steel erection and was used by the superstructure contractor. The northbound track was then completed from the north end of the relocation to the north end of the bridge in advance of steel erection and that end was also used by the superstructure contractor.

At Burnside a new combination freight and passenger depot was constructed by company forces. The building is 23×61 ft in size, of frame construction with asbestos shingles, sides and roof. It has concrete foundations and walls, asphalt tile floors in waiting rooms and office, a concrete floor in the freight room, aluminum windows, and warm-air heat. Chert platforms with concrete curbs surround the building.

The railway company's engineers cooperated with the industries and town officials in laying out the industrial section at the new location.

Under the terms of the railway company's agreement with the U.S. Government dated August 8, 1948, all tracks on the old location, including industry tracks at Burnside, were removed by the railway company's forces. Work began immediately after the new line was opened, the railway retaining all salvaged material except the steel in the old Cumberland River Bridge, to which the Government retained title. The bridge steel was sold to a scrap dealer who will remove it from the piers, and the piers will then be demolished.

The railway forces made rapid progress in their salvage operations to permit the Government's contractor early access to a part of the old roadbed south of Burnside, on which a part of the relocated U.S. Highway No. 27 is to be constructed.

Planning and construction of the entire project was carried out under the direction of the writer. Field surveys and plans for the final location and general supervision of construction of the project were under the direction of Lacy Moore, Engineer of Construction. J. B. Sutton was Resident Engineer in Charge. Substructure and superstructure of the Cumberland River Bridge were designed by Modjeski and Masters, consulting engineers, Harrisburg, Pa., with R. C. Holt, their Resident Engineer in charge of construction. C. M. Davis, M. ASCE, Fort Worth, Tex., developer of the sliding-form method used in building the piers, was consultant on that feature of the work. Massman Construction Co. was represented by T. W. Tisdale, Superintendent; Mt. Vernon Bridge Co., by J. A. Cowan, Superintendent; Oman Construction Co. and Moss-Thornton Co., Inc., by B. A. Beasley, Superintendent.

Point IV and the Civil Engineer

RALPH STONE, Assoc. M. ASCE

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THE CIVIL ENGINEER obviously has an important place in the Point 4 program since his branch of engineering provides for the initial development of natural resources and lays the foundation for other technical progress. Highways and railroads must be built, airfields layed out, and water supplied before modern industries can profitably develop. In the Point 4 program the civil engineer is needed as a leader and planner as well as a technologist.

Now that authorizing legislation to make Point 4 a reality is in effect, it is of interest to outline some of the ways in which the civil engineer can fit into this program.

It will be recalled that Point 4 began when President Truman in his inaugural address outlined four policies in the field of international relations which he believed the administration should emphasize—support of the UN organizations, continuance of the economic cooperation program for world recovery, strengthening of freedom-loving nations against the dangers of aggression, and (the fourth point) technical assistance to economically underdeveloped areas.

Of course American engineers in business organizations and private foundations have furnished technical assistance to other countries for a long time. Many manufacturing, mining and petroleum industries, as well as the Rockefeller, Carnegie and other foundations, have world-wide organizations. The value of other supplemental technical Point 4 activities has already been demonstrated in South America by branches of the government such as the Institute of Inter-American Affairs and a number of offices working through the Inter-Departmental Committee on Scientific and Cultural Development.

Nearly 60 Million Expended by IIAA

The Institute of Inter-American Affairs and predecessor agencies have expended $58,953,000 for field programs from 1940 to June 30, 1949, not counting the funds supplied cooperatively by the Latin American republics. The IIAA has an impressive record of accomplishment in its three divisions of agriculture, education, and health and sanitation. In cooperative health and sanitation *servicios* the Institute employs some 8,000 doctors, engineers, nurses and other personnel, approximately 120 of whom are from the United States. There are 550 specific projects now being carried out in 14 Latin American countries.

Of the previously mentioned total of $58,953,000 spent by the IIAA in the last ten years, $46,443,000 has been expended by the Health and Sanitation Division.

Varied Work Accomplished

Besides normal public health activities, the Institute's engineers have been involved in the design and construction of water supply and sewerage systems. Other health facilities, such as hospitals, health centers, abattoirs and other buildings have also been constructed. For example, in the Republic of Colombia, IIAA projects include:

A sewerage system for the City of Quibdo, capital of the Department of Choco.

A project for drainage and dredging in Barranquilla with the multiple purposes of malaria control and land and waterway reclamation; this project cost 2 million U.S. dollars or 8 million Colombian pesos.

Construction of the National Nursing School for 200 students at a cost of over $300,000 (1,000,000 Colombian pesos) as well as the building of four health centers (in La Dorada, Monteria, Buenaventura and Tunja) and a venereal disease hospital for Bucaramanga.

Since 1943, about 12½ miles of drainage channels have been dug in La Dorada. This work together with other malaria control measures has reduced the incidence of malaria in the population by 90 percent.

Thus it is evident that in Colombia the primary activities of the IIAA have been in the field of public health. Each republic places emphasis on the types of projects desired to meet particular local needs and conditions. In Venezuela, the development of safe water supplies is considered of paramount importance; in Chile a sewerage system was built for a metropolitan district of 200,000 people; and in a large valley in Brazil, typhoid fever and dysentery have been practically eliminated. Often consulting engineers are hired by the Institute to assist in the development of particular works.

U.S. Government and UN Contributions

In addition, from 1940 to 1948, over 1,550 U.S. Government experts were sent to the American republics by the Inter-Departmental Committee on Scientific and Cultural Cooperation. These experts worked on specific technical cooperation projects which varied from sanitary and public health engineering to geological surveys, soil conservation, airfield location and construction, highways, multiple-purpose water development, port and harbor development, railroads, statistics, shelter and urban planning, telecommunications, and so on through a host of non-engineering activities.

Similarly the United Nations has been active in sending out consultants to advise requesting governments on specific problems. The UN Food and Agricultural Organization Mission in Asia assisted in demonstrating soil utilization, pest control, and fertilizer manufacture. Similarly the UN World Health Organization has reduced the prevalence of malaria in Greece and has developed an over-all program involving engineering activities in such fields as environmental sanitation, research, and malaria control. The International Civil Aviation Organization, the International Telecommunications Union, the International Bank for Reconstruction and Development, and other international agencies, also have working projects and are obvious sources of specialized technical assistance. For Point 4 work, however, the UN is the agency to be utilized whenever efficiency indicates the advantage of such cooperation.

On a long-term basis the contributions of private U.S. groups have been much larger than those of U.S. Government agencies. The Point 4 program should provide a stimulus to expand such private activities. Wherever appropriate, the U.S. Government will utilize the services of consulting engineers on a contract basis for surveys and investigations as well as for construction and other economic development in connection with projects of Point 4 type.

Large Units Characterize Hydro Plant Practice

Turbines Rated at 85,000 hp Are on Drafting Boards

I. C. STEELE, M. ASCE

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LARGE UNITS and simplified operation mark the trend in hydroelectric construction, resulting in larger dams, more dependable water conduits and a decided reduction in the amount of manual labor required for operating spillways, raking trash racks and maintaining waterways. Greater emphasis is placed on large-capacity generators and turbines and the ability to get them up to full-load conditions in a relatively short time. Modern practice also favors centralized or automatic controls, simplified arrangements, and less duplication of auxiliary equipment.

Dams of larger and larger sizes are being built every year. Their construction has been justified for multi-purpose projects where a substantial part of the cost is allocated to other public benefits, and in other instances where the installed capacity of the powerhouse can be increased economically to provide peaking power for a large integrated power system. There is a continuing effort in concrete dam construction to obtain better concrete, to reduce the temperature of hydration and thereby reduce concrete shrinkage, and to use either absorptive form liners or the vacuum process on the forms to obtain a dense concrete surface resistant to freezing and erosion.

Earth dams and rock-fill dams are being constructed to great heights. This practice has made it necessary to use flatter slopes on earth dams, and on rock-fill dams has introduced problems of maintenance of the impervious concrete face. A relatively new type of dam of composite earth and rock fill is now being advocated. In this type the central section is of compacted earth and the two outer sections of loose rock fill, a filter bed being provided adjacent to the earth so that it cannot be washed into the rock fill. Other composite dams have been constructed with impervious material on the upstream face, the fill gradually becoming more and more pervious toward the downstream face. San Gabriel Dam No. I is of this type.

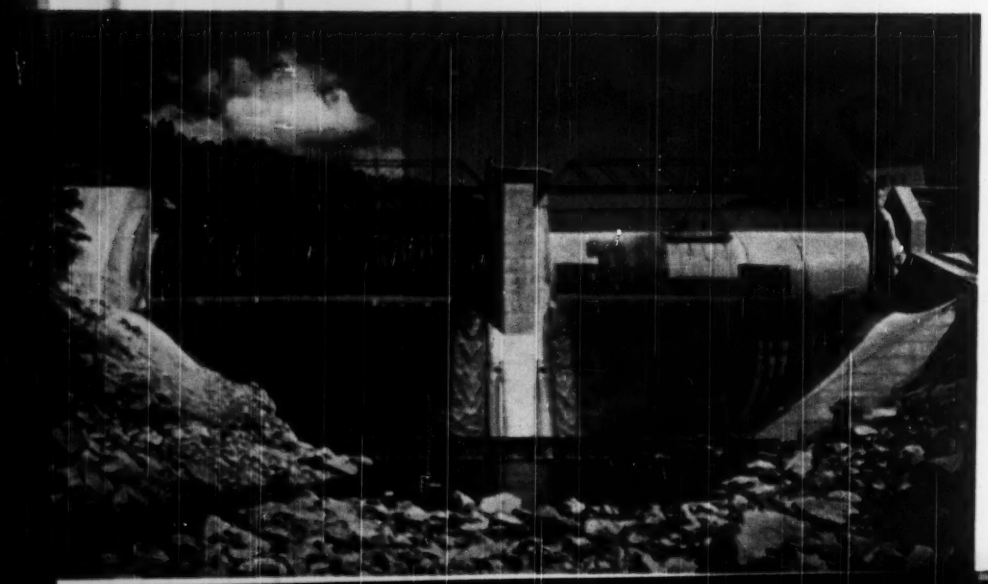
Drum gates of the types developed by engineers of the Bureau of Reclamation have been installed on many spillways. With this type of gate, the water surface can be controlled accurately by means of a large float operating the pilot valve of a balanced discharge valve connected to the main gate chamber. Drum gates can be made very large (some are 28 ft high by 135 ft long) and can operate without mechanical power. When lowered, gates of this size leave a wide, clear opening for the passage of floods.

Large wheel gates, roller gates and radial gates have also been widely used on many recent installations. They are generally less costly than drum gates and are therefore preferred where conditions do not justify clear spillway openings of great length, or where the power required to operate the gate mechanism is dependable. These gates are generally limited to about 50 ft in clear width.

Adequate sluices are a must in modern-day construction to facilitate unwatering for inspection and repair of crest gates and intake works as well as of the dams themselves.

Modern intakes are designed to produce a low velocity through the trash racks in order to protect fish life and to simplify the problem of removing the trash that accumulates on the grizzlies. With these larger intakes, manual removal of trash is extremely difficult; consequently automatic mechanical rakes are installed to insure rapid cleaning of the bars.

Large radial gates at canal intakes and large wheel or roller-type gates at tunnel entrances are now common practice. When the diversion con-



DRUM GATES installed at Cresta Dam illustrate trend toward larger and longer crest gates, to provide for rapid spilling of water when required. Gates of this type have been built as large as 28 ft high by 135 ft long.

duit is a tunnel, it has been found advisable to provide a large well on the downstream side of the gate in order to permit the passage of maintenance equipment in and out of the tunnel if required.

Recording devices often are installed to measure the velocity head in the section below the tunnel gate. With the resulting data it is possible to compute the flow in the tunnel with about the accuracy of a current meter.

Open-flow tunnels are used generally where a large-capacity forebay can be constructed near the power plant. Pressure tunnels are used where this is impossible or uneconomic. When a pressure tunnel is used, a surge tank must be placed at the downstream end to allow for rapid changes in flow to meet varying power demands on the plant.

The head on pressure tunnels may be 150 ft or more near the downstream portal. The rock must be sufficiently sound to resist these high pressures and also to withstand percolation. In some cases, steel liners are installed inside the tunnel for some distance back from the penstocks such as at the Pacific Gas & Electric Company's new Cresta and Rock Creek plants, where the surrounding material is decomposed granite, which would be subject to saturation from any tunnel leakage.

In the past not enough consideration was given to provisions for access to tunnels after they were placed in operation, with the result that repair jobs were difficult, time consuming and expensive. Adit plugs are now provided with access doors large enough to permit the entrance of reasonably large equipment.

Sluiceways installed at adits and immediately ahead of the penstocks are essential with unlined tunnels and good practice even with lined tunnels. Such sluiceways have proved of value in the removal of debris, gate leakage and seepage water when inspection or repairs were necessary. Butterfly valves have been used as sluice valves because they open rapidly and permit sluicing with a minimum waste of water.

Surge tanks of the non-spilling differential and restricted-orifice type generally have supplanted the simple type of tank, and have resulted in a substantial saving in cost, because such tanks are smaller than simple tanks and do not require a spillway. These tanks are also more satisfactory than simple tanks because they adjust themselves better to rapid changes in flow and they have an inherent damping action which prevents the building up of surges.

Penstock sizes have become larger with the decrease in the number of generating units. From a practical and economic standpoint it has been desirable in some instances to use special steels in order to reduce pipe thickness and facilitate field erection. Welding of all longitudinal joints, radiographing of welds and stress reheving of the shop section have become standard practice. Shop sections are limited to a diameter of about 13 ft because of transportation limitations. Field joints are either welded or riveted. On Pacific Gas and Electric installations, a collar is welded on one end of the shop section and the field connection is made with rivets. At Boulder Dam, driven pins were used instead of rivets. At Shasta Dam the large pipe sections were fabricated in the field and the joints were welded.

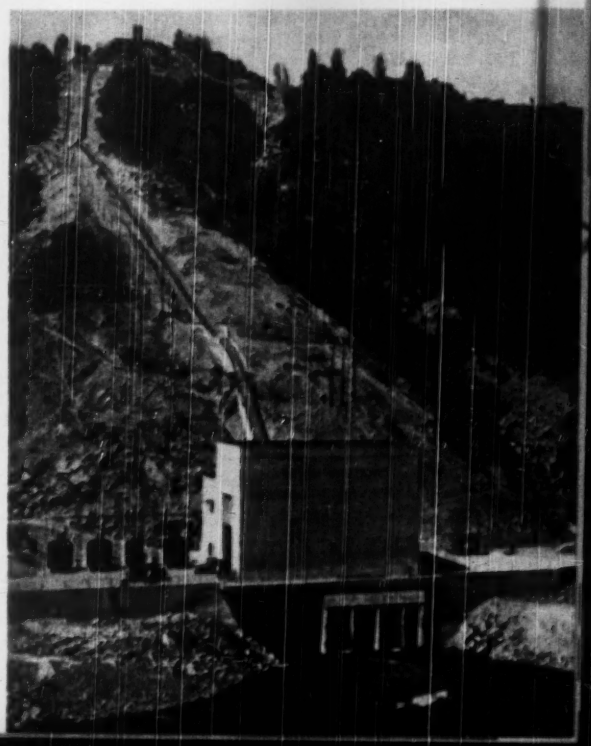
On the Bridge River project in British Columbia, special Dresser couplings were installed between all 30-ft penstock sections, eliminating special angle pieces, expansion joints and large anchors. This is an interesting installation but cannot be classed as a trend because the penstock profile is very uniform.

Valves at the head of the penstock are now commonly provided to protect the powerhouse and allied equipment in case of penstock failure.

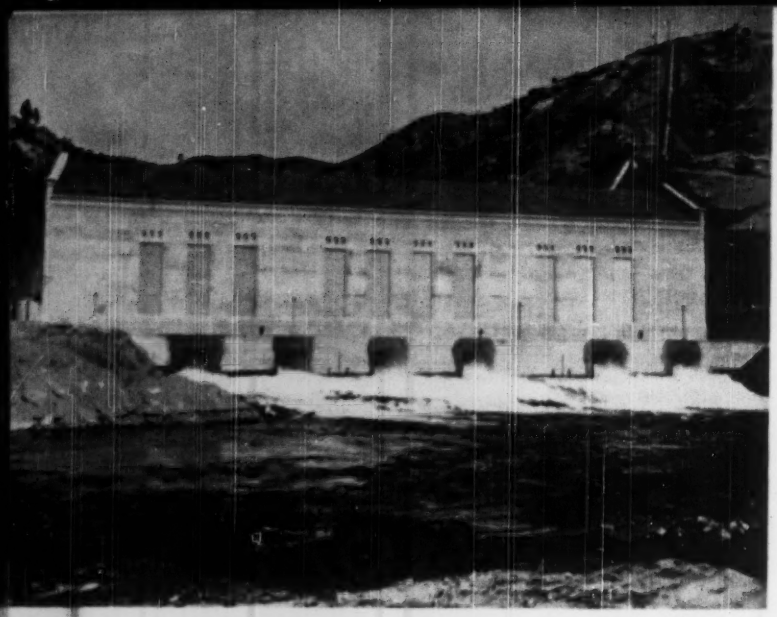
Clad metal inserts are now used in expansion joints, and permanent exterior ladders are installed to facilitate the taking up or repacking of the joint. Drainage along the penstock has been given more consideration in order to prevent erosion under piers.

Power-plant buildings are being simplified. Flat roofs have been used to reduce the cost of construction where snow loading is not an important factor. Glass bricks are used instead of steel sash. Provision is frequently made to reduce the dust contamination of electrical equipment by installing blowers equipped with air filters. The air is forced into the building through the filters and exhausted through vents near the roof, thus creating a light positive air pressure within the building. The switchboard room, offices and wash rooms are completely air conditioned. Floor hardeners are used to prevent dusting. The switchboard rooms are provided with soundproofing. Considerable attention is given to obtaining adequate illumination, fluorescent lighting being used extensively. These features tend to reduce to a minimum maintenance work, operating errors, and dissatisfaction of personnel.

Steel tailrace gates are recommended for both the draft tubes and



PENSTOCK anchors are poured only halfway up penstock at Pacific Gas & Electric Company's Colgate Powerhouse. Steel hold-down straps resist uplift. This method of anchoring penstocks, common practice on P. G. & E. projects, eliminates undesirable features due to complete encasement of pipe and has proved more economical.



PLANT WITH THREE double-overhung units rated at 37,500 hp each replaces old installation of seven impulse units with total capacity of 30,000 hp. This replacement is in keeping with trend toward rebuilding of older plants to get greater efficiency from sites. Double-overhung single-jet Pelton or impulse wheels like those installed in New Electra Powerhouse here shown, continue to be most common prime movers for heads of 1,000 ft or more. Head here is 1,223 ft.

the pressure regulating valves so that the equipment can be dewatered and repaired regardless of the tail-water elevation.

In places where free discharge valves are required, there is a trend toward the use of a valve in which the jet is made to fan out, thereby destroying considerable energy before the jet strikes the river channel. Butterfly valves, Staats-Hornsby hollow jet, Howell-Bungler and possibly other types have been used. The relative merits of each type could be discussed at length, but the designer obviously must consider his particular needs when selecting such equipment.

Transmission lines with longer spans are being constructed, particularly in valley locations. There are, therefore, fewer towers per mile. The use of mechanical equipment to bore holes for tower footings in soil has facilitated construction and materially reduced footing costs.

Larger size, simplification, and automatic control also characterize the new power plants and their associated equipment. These trends are in part the result of technological advances, but are even more the natural outcome of the effort to relate hydroelectric plants most economically to the large interconnected power systems of today. As part of an integrated power network, generating units of large size can be satisfactorily employed without requiring too great a proportion of the system generating capacity to be held in reserve against a possible machine outage. Smaller plants can be made completely automatic, or remotely controlled, without putting "too many eggs in one basket" from the system standpoint.

The maximum horsepower rating of a hydraulic turbine is set by limitations of shipment because of the physical size of the turbine runner, or of the sections of penstock pipe, or by the mechanical and hydraulic design problems of the unit itself. For example, as long as the Francis turbine runner must be made in one piece, the required shipping clearances will limit the maximum physical size of this type of machine. Large-diameter penstocks can of course be fabricated at the site when this procedure is justified by the over-all economics of the development. Within these limitations, the turbine designer is steadily pushing upward the horsepower ratings for the various turbine types.

At low heads, the largest propeller type will be represented by the 111,300-hp unit, adjustable-blade type, now being designed for operation at McNary Dam. In the moderate-head range, the 165,000-hp reaction turbines being installed at Grand Coulee indicate the upper range of development.

While a continuation of the trend toward units of greater capacity at low and moderate heads is to be expected, an important development in recent years has been the extension of reaction turbines into higher heads where formerly only impulse machines were used. Well-known examples of this trend are the 60,000-hp turbine at Nantahala, N.C., with a net head of 925 ft and a speed of 450 rpm, and the Extapantongo development in Mexico where a 39,000-hp unit is designed for a net head of 1,028 ft and a speed of 600 rpm. In Norway, Francis turbines operating under a 1,335-ft head are reported, but detailed information is lacking.

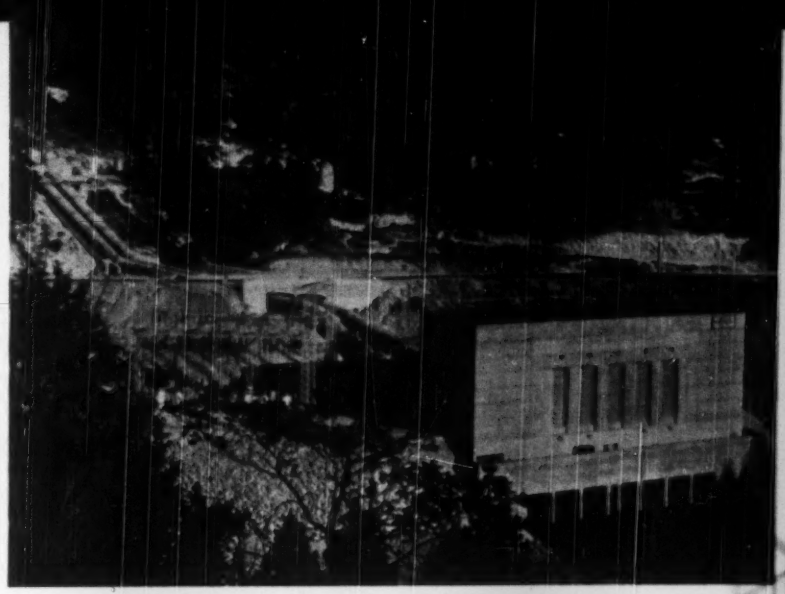
An interesting example of old and new practice on the Pacific Gas and Electric Co. system is the Colgate Power House on the Yuba River. This plant went into operation in 1899 with four impulse turbines, and in 1906 three more were added. These seven machines totaled 20,250 hp and operated at speeds of 240, 300, and 360 rpm. In 1949 this old plant was replaced, after nearly 50 years of operation, by a new plant containing a single 35,000-hp reaction turbine operating at a 728-ft net head and 450 rpm. It should be noted that the Colgate plant illustrates another important trend, that toward the replacement or rebuilding of obsolete plants to secure the benefits of modern design. There are a number of these smaller developments, constructed forty years or more ago, where the facilities could be replaced to advantage by more efficient modern equipment.

Reaction Turbines Invade High-Head Field

Extending the application of reaction turbines to higher heads is a significant trend because of the smaller physical size of the generator, due to the higher speed, and because of the greater machine capacities obtainable, as compared to the conventional impulse wheel. The efficiency of the reaction turbine, when new, is also higher.

Although the conventional impulse wheel is well suited to small developments at medium heads, and has been built in sizes up to 35,000 hp per runner at high heads, the trend toward larger machine capacities has been instrumental in bringing about the development of multi-jet, vertical-shaft impulse wheels with a greater horsepower per wheel.

A prominent example of this type is the Bridge River development of the British Columbia Electric Co., where three 6-jet vertical impulse units are now in operation, rated at



BANK OF THREE 25,000-kva, single-phase transformers (plus a spare) steps up power output of two 37,500-kva generators at Cresta Powerhouse to transmission voltage of 220 kv. Trend is toward large transformers; size is limited only by transportation restrictions.

62,000 hp each at a 1,118-ft net head and 300 rpm. Tests on these units have indicated a maximum efficiency approaching that of a Francis turbine. Furthermore, by cutting off one or more jets, relatively high efficiencies can be maintained at partial load. Other advantages of the multi-jet vertical unit include higher speed (speed is proportional to the square root of the number of jets) permitting smaller and less costly generators, a more desirable mechanical design, and simpler attachment of exciter as compared to the over-hung wheel. A practical limit of generator speed is set by the requirement for withstanding 100-percent overspeed in case of runaway. Although the Bridge River units are the largest of this type now in operation, ratings up to at least 85,000 hp are on the drafting board.

Accompanying the higher-capacity turbine developments, there have been corresponding improvements and new developments in the various types of valve gear. Butterfly valves continue to be widely used and in larger sizes. For higher heads, where a clear water passage is important, there have been recent applications of new valve design and extension of the application of existing types. At Bridge River the use of a new design of a spherical plug-type valve is notable, and at Electra Power House the use of the Rotovalve is an interesting and satisfactory development. Both valves operate by a rotary motion and eliminate the lengthy cylinder and sliding surfaces associated with the gate-follower type. Pressure regulators for the protection of penstocks from sudden pressure rises are built in larger sizes and for application at higher heads.

Larger Electrical Equipment Developed

Turning from hydraulic and mechanical equipment to electrical, similar trends are found. Since the generator must match the turbine, the trend in generator design has been largely toward increased size. Most of the major units in the past have been slow-speed, large-diameter machines. There was ample space and material in the spider rim to anchor the pole pieces securely to withstand an 85 or 100-percent runaway speed rise. With the development of high-capacity machines operating also at higher speeds than heretofore, the problem has become more difficult for the designer. At these higher speeds the generator is smaller in diameter and the poles are crowded more closely together. Secure attachment of the pole pieces to the spider rim is less easily accomplished. It is to be expected, however, that designers will develop economic solutions for these higher-speed, larger-capacity units.

Next to the generators the power transformers are usually the most costly part of the electrical equipment. The maximum physical size of power transformers in the more inaccessible hydroelectric developments may be limited by clearances or allowable weight on the route of transportation. Except for limitations of this sort, the trend is toward units of larger size with a lower cost per kva of capacity.

Sometimes no spare is provided. Because of the high degree of reliability of the modern power transformer, the elimination of a spare unit does not introduce a large element of risk, particularly when the load can be supplied from other sources if transformer repairs become necessary.

The larger machines of today and the strong electrical ties between the various plants in a system have imposed requirements on switchgear for higher current ratings and greater short-circuit interrupting ability. Development of low-voltage compressed-air circuit breakers adequately meeting these requirements, and competitive in cost with the oil circuit breaker, has led to adoption of the compressed-air type at generator voltages, because of the added advantage of eliminating oil and the accompanying fire hazard.

Although small hydro plants have been in operation for years with automatic or supervisory control, the proportionately greater savings now obtainable by eliminating operating personnel at smaller plants have caused renewed attention to this type of development. In general, load control on such plants is automatic from the intake water level, or is set on block by supervisory control from another plant on the same stream. Alarms are transmitted in case of failure of any equipment, loss of load, or other critical condition. Not only are new plants being constructed for automatic operation, but existing plants are frequently converted to automatic or supervisory control with a worthwhile saving in operating costs.

For a number of years power plants of the outdoor type have been built when conditions were favorable. In this design the generators are provided with a weatherproof housing and the building stops at the generator-floor level. A gantry crane is necessary to handle the equipment. The chief saving in this design is in the difference between the cost of a gantry crane and the cost of the building superstructure with its less expensive building crane.

Engineers in the hydroelectric field are constantly on the alert for improvements in design and construction so as to realize the lowest over-all costs commensurate with a high degree of safety and reliability.

(This article is based on a paper by the author presented before the Power Division at the ASCE Los Angeles Meeting.)

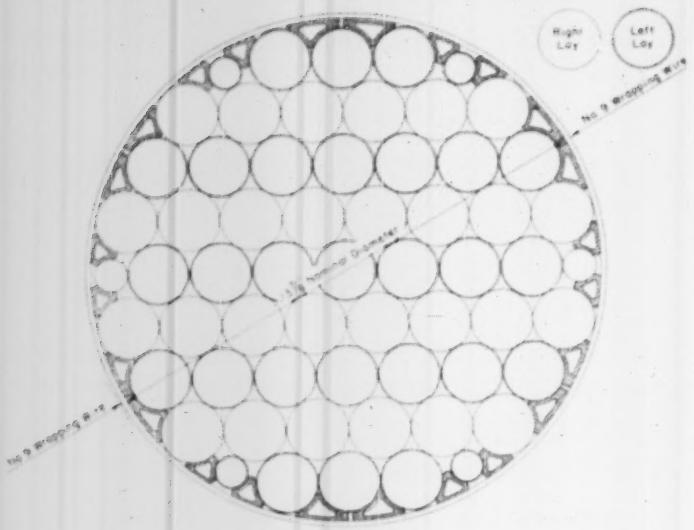


FIG. 1. CROSS SECTION of typical shop-fabricated, prestretched and measured galvanized steel bridge strands shows relative positions of 55 right-lay and left-lay strands and placement of six small strands and aluminum spacers. Lower strands of section of cable within saddle are subject to considerable cross-pressure.

Bridge Cables Tested for Effects of Cross-Pressure

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THE EFFECT of cross-pressure on the tensile capacity of main bridge cables has become increasingly important with the growing interest of bridge engineers in the use of shop-fabricated, prestretched and measured galvanized steel bridge strands, for bridges of both moderate and fairly long spans. Although tests have been made of the effect of cross-pressure, wire on wire, the writer knows of no tests reported on the effect of strand on strand. Accordingly, Bethlehem Steel Co., contractor for the superstructure of the Chesapeake Bay Bridge, typical of this type of design, decided to make as definite a test of this effect as could be devised, without the use of elaborate equipment.

Each of the two main cables of the 1,600-ft suspension span of the Chesapeake Bay Bridge (designed for the Maryland State Roads Commission by J. E. Greiner Co., Baltimore, Md.) consists of 61 strands—55 large strands (1.682-in. diameter) and 6 small strands (0.806-in. diameter). The large strands lie in nine horizontal layers of 3-6-7-8-7-8-7-6-3 strands each, from bottom to top (Fig. 1). The small strands are positioned around the circumference of the large strands in such a manner that the hexagonal form of the latter approaches a circular shape, which is desirable for better wrapping.

Strand Layers Nest Into Each Other

As may be seen from Fig. 1, the strands on each layer nest into the spaces above and between those in the layer next below, loading them in some diagonal direction. The total vertical weight of the bridge and its traffic, brought by the cables to the tower tops, is transmitted by the exterior strands of the cables to conforming grooves in the saddles.

FIG. 2. SCHEMATIC diagram of arrangement of test strands shows angle of cross-pressure on central strand (the one being tested). Four outer strands, left-lay, are under pressure only, and central strand, right-lay, is under tension and pressure. Central strand is about 7 ft between sockets; outer strands are about 2 ft long.

Within the saddles, in addition to the tension carried in the cables as they approach the towers, there is a considerable cross-pressure on each strand, increasing toward the bottom layers.

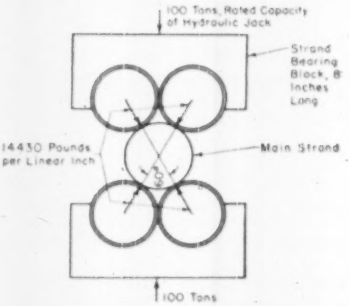
The contact between the lowest and outer strands in the cable and the saddle is distributed over several wires by reason of the grooved shape of the saddle, and is therefore not critical as to unit bearing. And since successive layers of strands are alternately right lay and left lay at the tangent lines of contact, their outer wires tend to nest and not to cross, again not creating a critical situation.

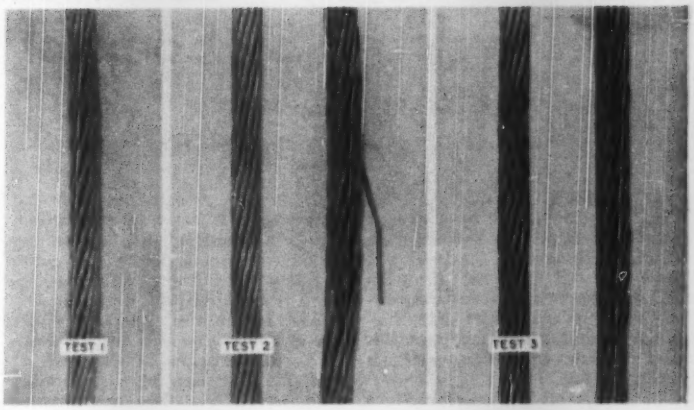
Critical Case for Tensile Strength

However, with successive layers of wires within the strand itself also being right lay and left lay, the wires of one layer do cross those of the next layer at an acute angle and on a small contact area. This is evidently the critical case in respect to reduction of tensile strength by cross-pressure.

The Bethlehem Steel Company's wire-rope plant at Williamsport, Pa., made up right- and left-lay galvanized steel bridge strands of the approximate wire sizes intended for the prototype strands.

Three lengths of the right-lay strand used for the ensuing tests were subjected to breaking-strength tests without cross-pressure and broke at an average load of 107,600 lb, or 222,000 psi (the average unit wire strength was 233,600 psi). The aim of the following program therefore was to find how much this tensile-strength value would be reduced by cross-pressure..


100 Tons, Rated Capacity of Hydraulic Jack
Strand Bearing Block, 8 Inches Long
14430 Pounds per Linear Inch
Main Strand
100 Tons



DISTORTION OF OUTER WIRES adjacent to broken wires is clearly shown in strands for tests Nos. 2 and 3, (two right photos). Strand in test No. 1 (left photo) was not broken as initial tension was not sufficient to cause rupture under 100-ton maximum capacity of cross-pressure jack.

The cross-pressure force was obtained by using a 100-ton hydraulic jack with a hand pump and a calibrated pressure gage operating inside the steel yoke. The tension was supplied by a vertical Olsen testing machine. The yoke and jack were suspended by an overhead hoist at about mid-height of the strand under test. Thus any desired simultaneous combination of tension and cross-pressure was attainable.

Six tests were made on six different lengths of the right-lay strand. In four, tension was held constant near the known ultimate, with the cross-pressure increasing. In one, the cross-pressure was held constant with the tension increasing. In the sixth test, tension and cross-pressure were increased *pari passu* at the rate of one ton of cross-pressure for 1,000 lb of tension, so that the ultimate load was reached with the cross-pressure close to the relationship in the preceding tests.

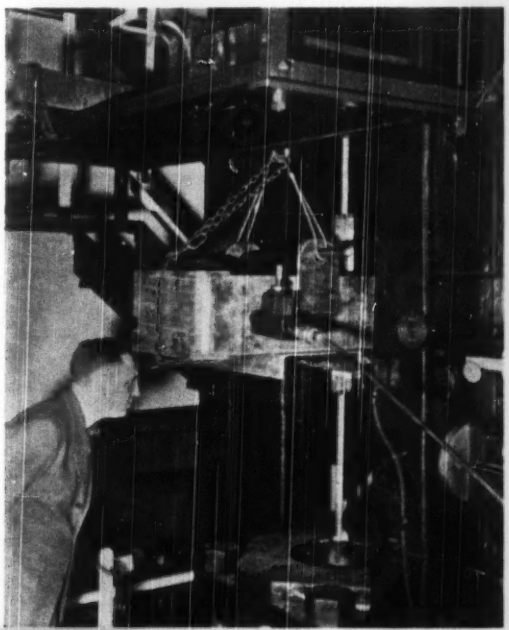
Except for the first one, all tests were conducted until breakage of outer wire or wires occurred in the strand under tension. In the first test, the preselected tension was insufficient to cause a tensile failure of the outer wire or wires under the cross-pressure capacity of the jack, and the test had to be stopped when that capacity was reached. The results of the tests in these three categories are given in Table I.

TABLE I. RESULTS OF CROSS-PRESSURE TESTS ON CABLE STRANDS

Conditions of Test	Applied Tension		Jack Pressure	
	Lb	% of Strand Capacity	Tons	Lb per Lin In.†
Applied tension constant and jack pressure increasing				
Test No. 2	100,000	92.9	0 to 64	0 to 9,240
Test No. 5	98,750	91.8	0 to 72	0 to 10,390
Test No. 3	97,500	90.6	0 to 78	0 to 11,260
Test No. 1*	95,000	88.3	0 to 98	0 to 14,150
Applied tension increasing and jack pressure constant				
Test No. 6	20,000 to 103,500	96.2	60	8,660
Applied tension increasing and jack pressure increasing				
Test No. 4	20,000 to 99,300	92.3	20 to 98	2,890 to 14,150

* Test No. 1 discontinued; no wires broken; jack capacity reached.

† Cross-pressures were obtained by multiplying total pressures, recorded in tons, by $\frac{2{,}000 \times 1.1547}{8 \times 2}$, where 8 is length of clamp in inches, 2 is number of jack-pressure components, and 1.1547 is sec 30 deg, the pressure angle (see Fig. 2).



CROSS-PRESSURE is applied to test strand by 100-ton, hand-operated, hydraulic jack, operating against a steel yoke. Jack and yoke are suspended from overhead hoist at point about midway down test strand. Tension is supplied by vertical Olsen testing machine.

The problem of the designer is to specify a working cross-pressure which, at the tensile unit stress selected for his cable design, will leave an adequate margin of safety. This cross-pressure will then determine the necessary length of cable within the saddle, which in turn dictates the radius of the saddle groove, and the saddle bulk and weight. It is therefore of economic importance to permit a realistic and not unnecessarily low cross-pressure.

The unit tensile stress permitted in the main cables under full loading is usually close to 80,000 psi for galvanized steel bridge strands which break at an average of 200,000 psi. The tests clearly indicate that cross-pressures up to 8,000 or 10,000 lb per lin in. will reduce the ultimate tensile strength by only a small percentage. With this fact available, a saddle design for any bridge of the suspension type can be evolved with complete assurance of safety and without resorting to an undesirable cable size.

Standard Tests for Construction Equipment Developed by Corps of Engineers

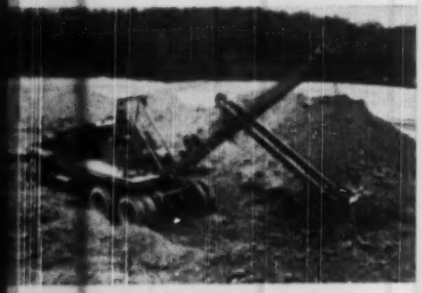
R. K. LOCKWOOD, Jun. M. ASCE

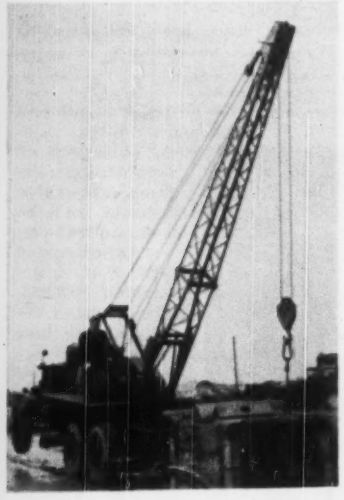
Associate Editor, "Civil Engineering," New York, N.Y.

STANDARD TESTING PROCEDURE for all types of construction equipment is now in the cards for the construction industry. As developed by the Corps of Engineers, the tests used are the product of close cooperation between equipment manufacturers and the military establishment. Benefits are realized by both parties.

The Corps of Engineers receives on loan (and free of charge) pilot models of construction equipment and runs a complete series of tests to determine operational characteristics for military use. The manufacturer in turn on request receives a full confidential report on the new piece of equipment with recommendations for improvements. Operational and design bugs can then be ironed out before or early in production. The advantages of standard testing procedures are obvious. The entire industry benefits when all new equipment is measured with a fixed scale.

The test center, operated under the Engineer Research and Development Laboratories, is located at ERDL's Engineer Proving Ground, Fort Belvoir, Va. The area contains $1^1/_2$ miles of paved concrete roads, 3,000 ft of pierced-steel runways, 15 miles of nearly vertical dirt trails to test mobility, streams, and a small lake to test amphibious qualities. A dynamometer course, suitable dynamometer testing equipment, and a super-accurate 100-ton scale are among the available facilities for test measurements. There is also a rock quarry for testing quarrying equipment, and sites for testing fire-fighting and petroleum distributing equipment.



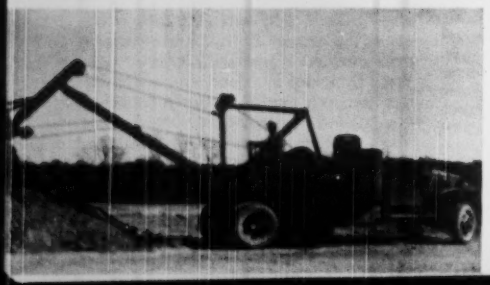


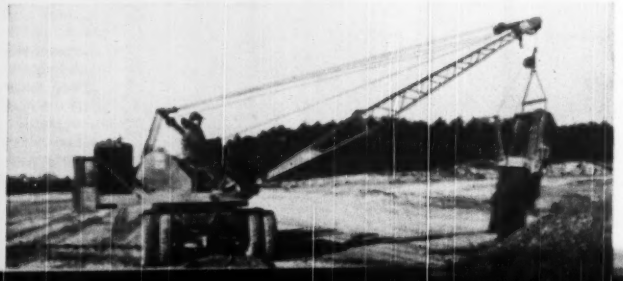
Tests of all equipment are carefully controlled and standardized against some common-denominator piece of similar equipment. For earth-moving equipment, soil conditions are carefully noted so that in future tests the material being excavated can be duplicated. The skill of the operator also is noted during each test, so that there is a true ratio between the actual operation of the equipment and the common-denominator item. In case appropriate testing conditions are not available at the proving grounds, the equipment is sent to an appropriate area, such as a hot western desert or an extremely cold area of Alaska, or Fort Churchill, Canada.

In some cases, when data on job operation are needed, the equipment is put into service on one of the Corps of Engineers civil works projects to move hundreds of thousands of cubic yards of material. In such cases, as in all other tests, complete records are kept of climatic and soil conditions during the test.

The complete testing procedure can be best explained by taking a typical example. Cognizant of the Army's interest in air-borne equipment the XYZ Crane Company developed a new light crane, mounted on a standard Army $2^1/_2$-ton, 6×6 truck. The crane can be operated with a shovel front, clamshell, dragline, trench hoe (backhoe) or a crane with hook. The manufacturer requested the Chief of Engineers to test this new item of equipment. After determining that the crane was worthy of a test, the Office of the Chief of Engineers directed ERDL to plan the equipment test. The project engineer in turn tells the

VERSATILE AIRBORNE CRANE is put through its paces at Engineer Proving Grounds, Fort Belvoir, Va. Standardized testing procedure gives Army accurate picture of capacities of equipment in relation to common-denominator crane. Beginning at upper left, photos show crane operating as shovel, clamshell, dragline, crane and hook, and trench hoe. Vehicular mount is standard Army $2^1/_2$-ton, 6×6 chassis.





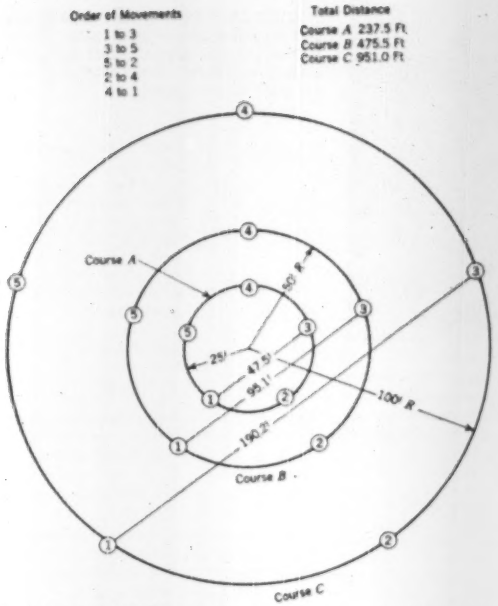


FIG. 1. STANDARD load transfer and placement course is run by all load-transfer equipment. Load is picked up at one station and put down at next station in sequence indicated. Only restriction is that equipment must stay within circle on which it is operating. Photo (above, right) shows XYZ Crane traversing course with 1,000-lb load. Test is also run with 50 percent and 85 percent of crane's maximum lifting capacity.

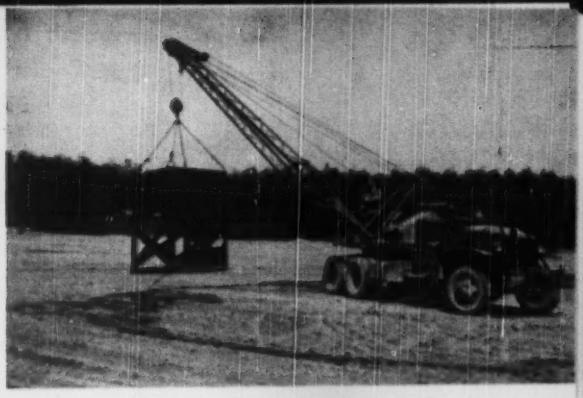


TABLE I. RESULTS OF LOAD PLACEMEMT TESTS ON XYZ CRANE, MODEL X

Values are average of two runs using two different operators and same truck driver

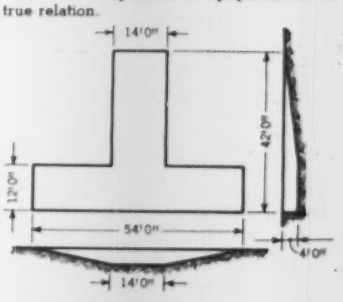
Course	Payload, Lb	Time, Min	Men Required	Tons per Hour	Tons per Man-Hour
A	1,000	1.8	3	16.7	5.6
B	1,000	1.8	3	16.7	5.6
C	1,000	2.7	3	11.1	3.7
A	2,000	1.5	3	40.0	13.3
B	2,000	1.5	3	40.0	13.3
C	2,000	2.1	3	28.6	9.5
A	3,500	1.9	3	55.3	18.4
B	3,500	1.9	3	55.3	18.4
C	3,500	2.8	3	37.5	12.5

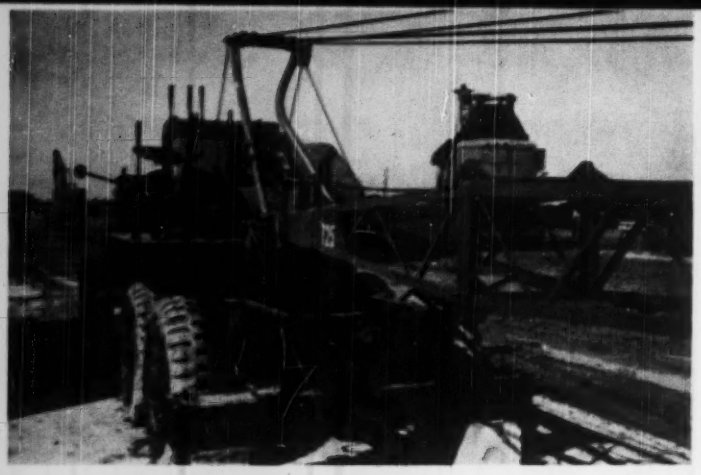
proving ground what tests to make, that is, he requests data on the various features of the crane. The project engineer's directive might read somewhat as follows:

Test Procedure for XYZ-Model Airborne Crane Mounted on Ordnance 2½-Ton, 6 × 6 Chassis

1. Project No.: 1-23-45-678.
2. Project Title: Cranes, truck-mounted.
3. Subject: Plan of test of crane shovel, truck-mounted, 2-ton capacity, with earth-moving attachments.
4. Purpose: The purpose of the test is to determine the military suitability of the subject crane and whether it meets the requirements for Airborne Operations.
5. Scope: Tests shall be made to determine:
   - A. Production capacity
   - B. Structural stability
   - C. Mechanical stability
   - D. Ease of operation
   - E. Adaptability to military airborne operations
   - F. Safety
   - G. Ease of maintenance
   - H. Mobility and transportability
   - I. Economy
   - J. Versatility
6. Physical Determinations:
   - A. Describe any novel and/or outstanding features—narrative.
   - B. General dimensions
   - C. Weights and weight distribution in travel position as:
     - (1) Crane
     - (2) Dragline
     - (3) Shovel
     - (4) Trench hoe
   - D. Center of gravity of unit as a crane with boom in low travel position.
   - E. Angle of approach and departure.
   - F. Check physical dimensions and performance dimensions (vertical clearance diagrams) to compare with manufacturer's specifications. Also prepare horizontal clearance diagrams to show effective operating range with relation to longitudinal axis of the truck when working as a crane, dragline, shovel, and trench hoe.
   - G. Determine tire pattern of crane for aircraft loading.
   - H. Weight of crane superstructure and crane boom removed from truck.
   - I. Weight of truck with crane superstructure removed.
   - J. Frame height of truck.
7. Mobility and Transportability:
   - A. Mobility: Test as a crane for mobility observations over the different types of terrain available for test and over surfaced roads.
   - B. Travel Speeds: Determine acceleration characteristics up to top speed and maximum speed for each gear selection.
   - C. Traction Efficiency: Determine maximum reserve rimpull for first and second speeds forward.
   - D. Brake Tests: Determine distance required to stop the truck crane at 10, 20, 30, and 40 mph.
   - E. Maneuverability: Determine vehicle turning radius and clearance required to make a "U" or 180-deg turn.
   - F. Transportability: Determine the adaptability of the test unit for shipment by land, sea, and air. Indicate the suitability of the unit for military processing and packing by transport vessel and aircraft, as a cargo load, and as a combat load.

FIG. 2. STANDARD PIT is dug by all excavating equipment. Nature of soil and skill of operator are carefully controlled so that relative capacities of equipment are in true relation.





FAILURE OF A-FRAME front angular members is studied to determine cause. Recommendations are made to manufacturer to correct weakness. Some design changes are made in field during tests.

8. Operation: Conduct operational tests to determine production capacity, operating and maintenance characteristics, adaptability to military applications, structural stability, and possible safety hazards.

A. Crane Operation: Determine capacity as follows:

(1) Load lifting capacity at different operating radii to establish minimum and safe (85 percent of maximum load) load capacities over side and over end with and without outriggers. Determine maximum load that may be transported safely suspended from the hoist line over end and over side at creeping speed.

(2) Load placement tests to determine load transfer rate.

(3) With dual wheels:

(a) Without counterbalance.

(b) With counterbalance enough to give 4,000-lb lift at 15 ft, both over end and over side.

B. Shovel Operation: Test shovel operation to determine:

(1) Production capacity in cubic yards per hour at 90-deg swing in soft sand-gravel mixture that has been stockpiled, preferably windrowed. Also make limited tests to determine whether the unit will effectively remove undisturbed gravel, sand, and clay formations.

(2) Fuel consumption in gallons per hour at normal operation.

(3) Simplicity of replacing bucket teeth.

C. Dragline Operation: Test operation using a dragline to determine:

(1) Production capacity in cubic yards per hour at 90-deg swing in hard soil. Indicate type of material handled (CE classification).

(2) Fuel consumption in gallons per hour at normal operation.

(3) Simplicity of replacing bucket teeth.

D. Trench-Hoe Operation: Test operation using a trench hoe to determine:

(1) Production capacity in cubic yards per hour at 90-deg swing in different types of soil. Indicate type of material handled (CE classification).

(2) Fuel consumption in gallons per hour.

(3) Simplicity of replacing bucket teeth.

E. Clamshell Bucket

(1) Test capacity.

(2) With dual wheels:

(a) With counterbalance.

(b) With counterbalance enough to give 4,000-lb lift at 15 ft, both over end and over side.

9. Installations: Determine time, personnel, and facilities required for installation and removal of each of the following:

A. Crane boom

B. Shovel front

C. Dragline

D. Trench hoe

10. Ease of Control and Adaptability to Operation:

A. Operation training requirements and degree of skill to operate the unit as a crane, shovel, dragline, and trench hoe.

B. Adequacy of operating controls with respect to arrangement, spacing, and effort and coordination required for manipulation.

C. Factors in operation contributing to fatigue and discomfort such as control manipulation, control location, riding comfort, vision.

D. Time required to start engine.

11. Safety: Determine adequacy of visibility, steering, locks and stops, braking, and operational stability.

12. Ease of Maintenance:

A. Check manufacturer's lubrication charts to determine whether U.S. Army lubricants can be used at all lubrication points, accessibility of lubrication points, and frequency of lubrication required.

B. Accessibility of accessories which require routine maintenance and/or adjustments.

13. Mechanical Deficiencies: Record mechanical deficiencies developed during tests, probable cause, and corrective action.

14. Durability: List any components which are not considered to meet the durability requirements for equipment of this type.

TABLE II. RESULTS OF CONTROLLED PRODUCTION TESTS ON XYZ CRANE

Attachment	Type Operation	Type Material (CE Class.)	California Bearing Ratio Value	Volume, Cu Yd	Time, Hours	Production, Cu Yd per Hr	Fuel Consumption	
							Gal	Gal per Hr
Dragline	Trench	GC	20-25	61.0	3.92	15.6	4.9	1.20
	Trench	GS	10-15	41.0	1.66	24.7	2.1	1.27
	Stripping	GS	10-15	126.3	2.71	46.6	3.3	1.22
Clamshell	Loading trucks from stockpile	GC		188.6	2.61	72.3	3.1	1.23
Shovel	Pit type excavation	GC	15-20	123.0	3.00	41.0	5.0	1.67
	Loading trucks from gravel bank	GC	15-20	193.5	1.98	97.9	3.2	1.62
Trench hoe	*Trench	SC	25-30	57.0	2.32	24.6	3.5	1.51
	†Trench	SC	25-30	51.0	2.49	20.5	4.0	1.60
	*Trench	GC	15-20	59.8	2.33	25.6	3.1	1.33
	†Trench	GC	15-20	59.0	2.92	20.2	4.7	1.61

* Excavated to approximately 6-ft depth.

† Excavated to maximum depth.

‡ GC = Clayey gravel.
GS = Sandy gravel.
SC = Sandy clay.

§ Average fuel consumption for all operation is 1.43 gal per hour.

15. Photographs:
   A. To describe equipment—to include quarter front view of crane in travel position.
   B. Views suitable for standardization photographs as specified in SO 202.02, paragraph f (2), pages 14a and 14b.
   C. Unusual and/or outstanding features.
   D. Major failures.

16. Economy: Log lubricants and fuels used during tests and record servicing and adjustments required during tests.

Test Load Placement Capabilities

Some of the tests are obvious. Speed tests require an area large enough to drive the crane to its top speed in various gears. Turning radii are determined by turning the crane around. In order to get comparable load placement and transfer tests the proving grounds has devised a standard test that is given to all load transporting equipment. The test is simple, requires very little equipment, and gives an accurate picture of the transfer and placement characteristics of the machine.

For this test the ground is first marked with three concentric circles, 100, 50, and 25 ft in radius, as shown in Fig. 1. Each circle is then marked with five stations, equally spaced around the circumference. The crane must pick up a 1,000-lb load at Sta. 1, carry it from station to station in accordance with a control pattern, and put it down. This procedure is continued until the load has been picked up and moved across the circle to each of the five stations. The performance is timed against both tons per hour and tons per man-hour (Table I). As the piece of equipment moves from a larger to a smaller circle, an accurate picture of its mobility is obtained.

All excavating equipment is required to dig a standard-size, T-shaped pit (Fig. 2). A regulation (TO&E) Army soil-testing unit assigned to the proving grounds, assures controlled conditions of the soil. For draglines, backhoes, or trenching machines the equipment digs a standard-size trench (of fixed cross section) and time is plotted against length of excavation. When a fairly constant figure is obtained the equipment is rated on its average production. See Table II for a typical test report.

One of the biggest problems of the proving grounds is to convert mechanics into research men. The "fix-em-fast" philosophy of the highly trained mechanic has to be overcome, as his primary function at the testing ground is to determine the cause of mechanical failure. The hours of dead-line time for the equipment are not particularly important as long as the failure is correctly analyzed. During this phase of testing, field changes in design are frequently made. Manufacturers send representatives along with the equipment to expedite the procurement of parts, and to study the design at the time the tests are being made so that first-hand information will be available to the factory. The manufacturer's representatives also instruct the Army personnel in the operation of the equipment.

At the conclusion of all the tests, when all the test data are available, a final report is written. The report includes not only the data obtained but the recommendations of the proving grounds for improving equipment for both military and civilian use.

The final report reflects the opinions of the operators concerning ease of operating the equipment. Were the controls conveniently placed? Was the cab of the unit comfortable or did it tire the operator excessively? Was visibility good? How about safety of operation? The tests even evaluate the ease of packaging and transporting the equipment.

Resulting from this hand-in-glove relation between the military and the manufacturers is the greater use of rubber-tired equipment because of the demand for greater speeds and high rates of operation. The early limitation of rubber-tired operations to good ground and dry weather has been reduced by the increased efficiency of low-pressure tires.

The pattern of future development seems to indicate a family of snow-removal equipment for the Army, interchangeable attachments for various models of cranes, use of gas turbines in equipment to solve some of the arctic-winter starting problems, development of equipment to open ways in areas contaminated by radioactive particles, a family of truck cranes in sizes up to 35-ton capacity, and a full line of lightweight, high-capacity airborne construction equipment.

Besides developing a complete issue of construction equipment for military uses, this program of equipment testing worked out by the Corps of Engineers, with the full cooperation of the manufacturers, promises continuing high quality of equipment for the American construction industry.

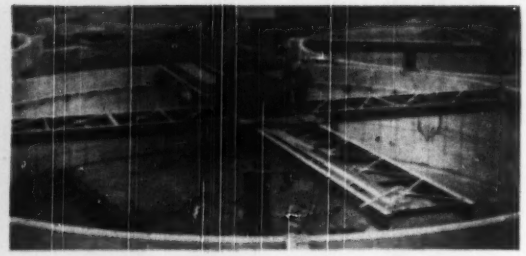
Appreciation is expressed for the cooperation given in the collection of the above material by Robert W. Beal, Chief of the Machinery Group at the ERDL; by A. J. Rutherford, Chief of the Equipment Testing Section at the Engineer Proving Grounds; and by A. A. Howell, Technical Information Officer, ERDL.

Suspended Solids Removed from Sewage by Mechanical Methods

W. VINCENT BARRY, M. ASCE
City Engineer, New Haven, Conn.

NEW HAVEN, CONN., discharges about 30 mgd of effluent from its two primary treatment plants into New Haven Harbor. Since this body of water has been defined as Class A by the Tri-State Authority of New Jersey, New York and Connecticut, the amount of suspended solids in the harbor must be reduced by at least 60 percent. This goal is reached only intermittently by New Haven's two existing primary treatment plants—the East Side Plant, which has three 20-ft-deep by 55-ft-square Dorr tanks, and the Boulevard Plant, which has three 37-ft by 93-ft straight-line Link Belt tanks. For this reason and because reduction requirements are increased from time to time, the city decided to improve the efficiency of its primary treatment so as to consistently maintain the required standard.

In connection with the city's new East Shore sewerage system, two



CONSTRUCTION OF THREE 4.5-mgd Clariflocculators for New Haven's new East Shore sewage treatment plant increases removal of solids from New Haven Harbor to conform with clean-up program of Tri-State Authority.

methods of improving removal in primary treatment were studied—chemical flocculation and mechanical flocculation. Since it has become increasingly difficult to obtain chemicals even for conditioning sludge, mechanical flocculation, if it could be proved successful, would be the answer from both the operating and the maintenance standpoint. An investigation of the mechanical flocculating equipment available early in the 1940's did not bring to light anything that would give the desired results.

Experimental Unit Tested

Continuing this search, the Clariflocculator made by the Dorr Co. was investigated. To make sure that a satisfactory increase in solids reduction would be achieved, an experimental laboratory-sized unit was installed in March 1945 to function in parallel with the existing plant. This model unit was so designed as to approximate the results of a full-scale unit. Recorded results indicated that it would be reasonable to expect an increased reduction of solids of from 8 to 10 percent over that accomplished in the same sewage by the existing plant.

The Clariflocculator, shown in Fig. 1, is installed in a special round tank, divided by a circular baffle into an inner circular compartment and an outer annular one. Raw sewage enters centrally through an inverted siphon and overflows the periphery of a continuous circular weir. Settled solids are removed from a central depression in the bottom of the tank.

A flocculator mechanism is installed in the central compartment to promote rapid flocculation of the raw solids to heavy, dense agglomerations having good settling qualities. A part of the settled floc is subsequently returned to this compartment to provide nuclei for the formation of new floc growths. The well-flocculated solids then pass quietly into the outer annular compartment, where continuous sedimentation takes place. Here a mechanism rakes the settled flocs to the central discharge opening. The flow of floc from the flocculation to the sedimentation compartment is so gentle that the flocs are not disintegrated or their settling qualities impaired.

Two drive heads transmit different speeds to the two vertical shafts, concentrically arranged, one within the other. The outer tubular shaft rotates at a relatively higher speed than the inner solid shaft and drives the moving elements of the flocculator. The inner, slower shaft drives the clarifier mechanism in the sedimentation compartment.

The moving elements of the flocculator consist of a series of rotating, wedge-shaped, vertical paddles. In their travel they intermesh repeatedly with corresponding fixed, vertical paddles suspended from the transverse beams. The net effect is a gentle controlled agitation in the flocculation zone—somewhat similar to a series of "barrel rolls"—which gives the raw solids the maximum opportunity to impinge upon one another and grow to heavy, dense floc formations.

The Clariflocculator combines in one unit the conventional combination of flocculators and clarifiers in separate tanks and occupies about the same space as a single clarifier of the same capacity.

Three Clariflocculators Constructed at East Shore Plant

Three 4.5-mgd Clariflocculators have been constructed at the East Shore Plant by C. W. Blakeslee & Sons, Inc., general contractors of New Haven. At the time of construction groundwater was high over the site, but explorations revealed an isolated area where there was a rock formation suitable for the foundations of the tanks. No piles or special concrete foundations were required. Well points unwatered the site. The cost of the work was $400,000.

The East Shore sewerage system includes pumping stations, siphon, and force mains. In addition to topographic obstacles, the presence of rock over most of the area, and of groundwater in the rest, increased construction difficulties. The project includes a 4,000-ft outfall with its outlet in the channel 2,000 ft offshore at a depth of 35 ft below high tide.

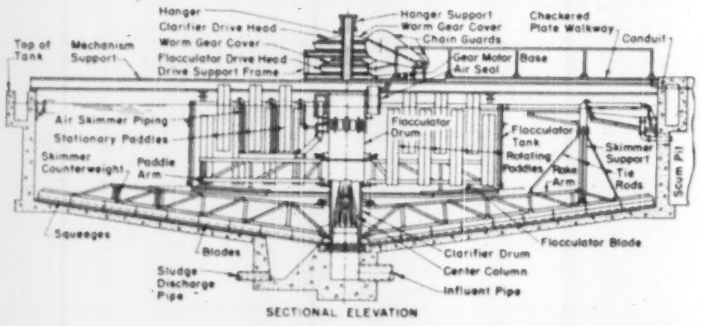


FIG. 1. COMBINATION of conventional flocculator and clarifier in one tank in Dorrco Clariflocculator, which has about same capacity as conventional clarifier and flocculator—which together would occupy twice the space.

Engineers' Notebook

Nomograph Simplifies Solution of Complex Water-Main Systems

GLENN E. HANDS, Assoc. M. ASCE
Principal Engineer, Burns & McDonnell Engineering Co., Kansas City, Mo.

A COMPLICATED SYSTEM of small and large water mains appears at first glance to involve an endless problem not practical of solution even by the method of analysis developed by Hardy Cross, Hon. M. ASCE. However, his method of solving network problems actually increases in value as methods of simplification are developed. A system can be simplified by combining mains that are parallel or approximately parallel to one another. This operation can be simplified by the use of nomographic charts.

The following equation has been developed from the Hazen and Williams formula for determining the loss of head between two points:

$$h_f = RQ^{1.85} \quad \ldots \quad (1)$$

Where mains are approximately parallel, the head loss is equal between two connecting points regardless of the route taken through the parallel mains. Therefore the mains can be combined into a single main according to the following equations:

$$h_f = R_1Q_1^{1.85} = R_2Q_2^{1.85} = R_3Q_3^{1.85} = R_4Q_4^{1.85} \quad \ldots \quad (2)$$

also,

$$Q_1 + Q_2 + Q_3 + Q_4 = Q \quad \ldots \quad (3)$$

Thus, assuming $h_f = 1$,

$$Q = \left(\frac{1}{R_1}\right)^{0.54} + \left(\frac{1}{R_2}\right)^{0.54} + \left(\frac{1}{R_3}\right)^{0.54} + \left(\frac{1}{R_4}\right)^{0.54} = \left(\frac{1}{R_c}\right)^{0.54} \quad \ldots \quad (4)$$

Therefore, $R_c =$

$$\left[\frac{1}{\left(\frac{1}{R_1}\right)^{0.54} + \left(\frac{1}{R_2}\right)^{0.54} + \left(\frac{1}{R_n}\right)^{0.54}}\right]^{1.85} \quad \ldots \quad (5)$$

where R_c = resistance factor of the equivalent main.

This equation appears cumbersome but can be solved quite readily with a log-log duplex slide rule, or the solution is simplified to a mere routine by use of the nomograph, Fig. 1.

Example Shows Use of Nomograph

For example, in the four water mains of Fig. 2, the resistance factor R in Eqs. 1 through 5 must be expressed in terms of the units of measure used in the formulas. In this example, the resistance factor is calculated for Q expressed in terms of million gallons per day, and loss of head, h_f, expressed in feet. The equation

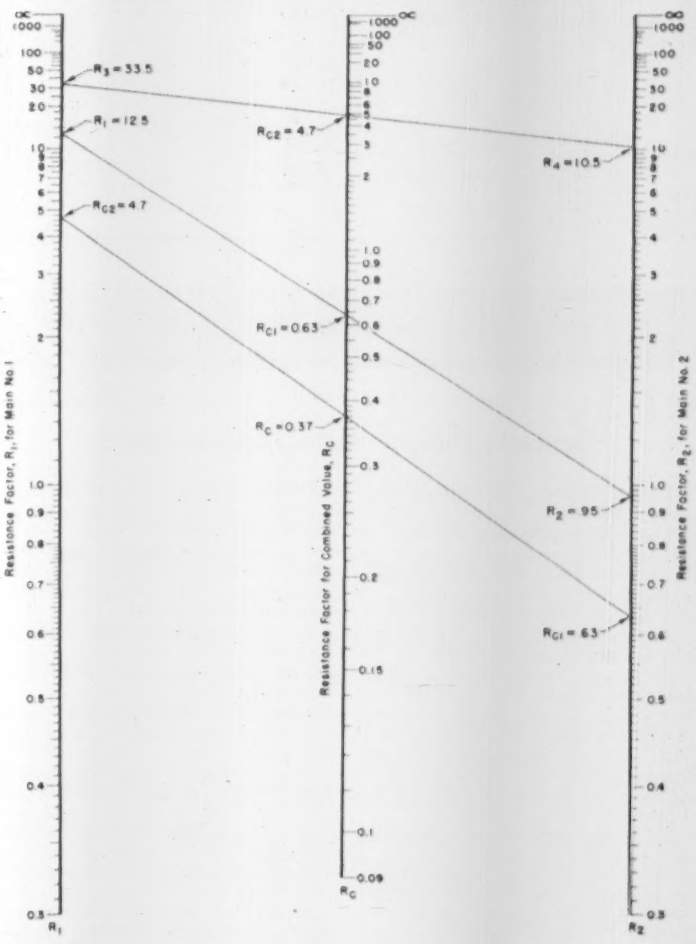


FIG. 1. NOMOGRAPH gives quick solution for parallel water mains.

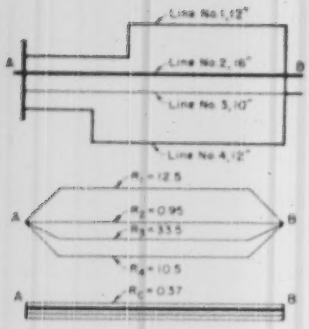


FIG. 2. TYPICAL GROUP of approximately parallel water mains (top) is simplified (middle) and finally combined (bottom) to give easy solution by Hardy Cross method.

for determining the resistance factor per 1,000 ft of water main, as developed from the Hazen and Williams formula, is

$$r = \frac{10{,}580}{C^{1.85}\left(\frac{D}{12}\right)^{4.87}}$$

where r = resistance factor per 1,000 ft
C = Hazen and Williams coefficient of roughness
D = diameter of pipe in inches

TABLE I. CALCULATION OF RESISTANCE FACTORS FOR FOUR MAINS OF FIG. 2

Equiv. Main	Main Size, In.	Length, Ft	H. & W. Coefficient	Resistance Factor: Per 1,000 ft, r	Resistance Factor: Total R	Identification
A-B	12	5,000	90	2.50	12.5	R_1
	16	3,800	150	0.25	0.95	R_2
	10	3,800	75	8.80	33.5	R_3
	12	5,000	100	2.10	10.5	R_4

This equation is readily solved by tables, charts, or nomographs. In this example the resistance factor of each of the four mains is determined as shown in Table I. Combining these four mains according to Eq. 5, the following calculations are necessary:

Line No.	Values of R	$\frac{1}{R}$	$\left(\frac{1}{R}\right)^{0.54}$
1	12.5	0.08	0.256
2	0.95	1.053	1.028
3	33.5	0.0298	0.150
4	10.5	0.0952	0.281
		Sum of $(1/R)^{0.54}$ =	1.715

$$R_e = \left(\frac{1}{1.715}\right)^{1.85} = (0.582)^{1.85} = 0.369$$

The solution is simplified to a mere routine by the use of the nomiograph, Fig. 1, as follows: R_1 and R_2 are combined by setting a straight-edge on the respective R values on the outer scales of Fig. 1 and reading the combined R on the center scale. The process is repeated for R_3 and R_4, reading their combination on the center scale. The two combined values are finally combined to give R_e for the four mains considered as an equivalent pipe.

R_1 combined with R_2 = 0.63 = R_{e1}
R_3 combined with R_4 = 4.70 = R_{e2}
R_{e1} combined with R_{e2} = 0.37 = R_e

In this way any number of mains can be combined into one equivalent pipe having the resistance factor of the combined mains. The group of water mains shown in Fig. 2 becomes a part of several loops of the system which may be simplified in like manner. By methods already described in the literature the entire system can be solved with only a fraction of the work involved in attempting to solve the complex network.

...THE READERS Write

Concrete Flexural Theories Questioned

To the Editor: The writer is gratified by the interest taken in his article, "When Concrete Becomes Discrete," in the April issue, and his letter of correction in the May issue. Regarding the criticisms and comments published in the July issue, the following reply is offered.

Professor Sawyer states that the new theories of concrete in flexure are not based on the "post-ultimate range (of cylinders), because this range has little significance for an actual structure." While agreeing as to the complete lack of significance and general structural worthlessness of this post-ultimate range, the writer would inquire, on what else but this are the new theories founded?

Of the two theories known to the writer, that of Charles S. Whitney, M. ASCE ("The Plastic Theory of Reinforced Concrete Design," Transactions of ASCE, 1942, p. 251), is stated to embody the findings of "research"—a word to conjure with—but the only physical evidence submitted consisted of the test of concrete cylinders made by two students at the University of Wisconsin. Their stress-strain curves were quite like those shown in the writer's article but unfortunately there was failure either to observe or to report the cracking that must have developed in their cylinders at extreme strains. On this basis Mr. Whitney proposed a new rectangular pattern of stress-distribution for concrete in flexure as a substitute for the familiar "straight-line" pattern.

The second theory is that propounded by Prof. Vernon P. Jensen, then Research Associate Professor of Theoretical and Applied Mechanics, University of Illinois ("Ultimate Strength of Reinforced Concrete Beams as Related to the Plasticity Ratio of Concrete," Bulletin Series 345, June 22, 1943, Engineering Experiment Station, University of Illinois). It also appeared as a paper of the American Concrete Institute ("The Plasticity Ratio of Concrete and Its Effect on the Ultimate Strength of Beams," *Proceedings of A.C.I.*, 1943, p. 565). The basis of this theory appears to be the stress-strain behavior of concrete cylinders up to the maximum, combined with a speculation by Saliger as to what *may* be the stress-strain curve beyond the maximum stress value. From this conjectural origin a new trapezoidal pattern of stress distribution for concrete in flexure is developed as a substitute for the familiar "straight-line" pattern. In essence the Jensen pattern is but a refinement of the Whitney pattern. Both patterns are identical in their lack of an acceptable physical basis. The only evidence apparently substantiating the Jensen stress pattern is the flexural test of beams conducted, of course, in a relatively brief period of time.

Because these are the two major American papers on the subject, the writer would question the correctness of Professor Sawyer's statement that "the new

theories of flexure are actually based on the action of concrete under stresses less than the ultimate." To the writer they appear to be based on sheer assumption. Actually if any theory of concrete in flexure is to be developed that will comprehend its long-time behavior under sustained loads, it must be founded, not on speculation but on definite, tangible evidence such as that embodied in Professor Sergev's 1934 paper ("Deformation of Steel Reinforcement During and After Construction," TRANSACTIONS of ASCE, 1934, p. 1343). So far as the writer knows there are no such new theories of concrete in flexure.

In an elastic material, stresses and strains are proportional and simultaneous; in non-elastic ones they are not. For sudden loads concrete may be regarded as elastic; for long-time loads it is slightly inelastic. Whether a testing machine applies strains or loads to a concrete cylinder appears to depend almost wholly upon one's preference in outlook; the two are inseparable. So it would be likewise with a column in a structure. For a long-time load the column's stress-strain curve would undoubtedly be a modification of the writer's Curve X, but that fact is utterly irrelevant to either the proposed Whitney or Jensen stress patterns.

Engineering has been defined as an exact science—based on assumptions. The denial by Professor Sawyer and Mr. Topping that circumferential tension exists in a concrete cylinder subjected to axial compression well illustrates the truth of this statement. Their denial is based on the assumption that all columnar elements are equally loaded. They are correct if this assumption is realized, incorrect if it is not. Since the central elements are stiffer than the marginal ones, they automatically—and contrary to assumption—receive more load and exert a greater outward thrust than the outer ones do. How an increase in diameter, with an accompanying π times that increase in circumferential dimension, is to be reconciled with the absence of circumferential tension in concrete cylinders which crack vertically is indeed an interesting problem. Why otherwise does the concrete cylinder develop vertical cracks, "without lateral stress"? Possibly it is the sheer perversity of the material.

Between Professor Grinter and the writer there is no disagreement concerning the long-time plasticity of concrete. This plasticity is very real. Fortunately it seldom evidences itself in building work where, in general, spans are short and depths are not overly shallow. But in long bridge spans it can become painfully evident if not foreseen and if proper initial camber is not provided. There was no thought of denying the long-time plasticity of concrete in the writer's article.

But admittedly there was hope that this report on the post-ultimate performance of test cylinders would lead to recognition of the fallacious bases of the Whitney and Jensen plastic and ultimate theories of design, which assume that concrete remains sound and intact in the "plastic range." Speculations and pronunciamentos are completely inacceptable as the basis of engineering design.

HOMER M. HADLEY, M. ASCE
Consulting Engineer
Seattle, Wash.

St. Lawrence Power Project Held Sound

TO THE EDITOR: In an article on the St. Lawrence Seaway in CIVIL ENGINEERING for March 1950, Lacey V. Murrow, Assoc. M. ASCE, intimates that "currently" there is no power shortage. Then he says, "Authentic information (he doesn't say from where or by whom) shows that new generating equipment is being put into commission in New York State at a faster pace than the growth of the load." Would private capital make a mistake like that? "Currently" there is no shortage or, putting it in a different way, there is no prospect of a demand greater than that which now exists, and yet someone is putting in new equipment at a faster pace than the growth of the load. Are those same unmentioned authorities making that error?

Mr. Murrow says, "There is a basic misconception of the place which the St. Lawrence power would occupy in the general requirements of the area. The proposed plant on the American side would have a firm dependable capacity less than that of any one of several steam power plants in New York—that is, the Hudson Avenue Plant in Brooklyn, the Waterside Plant in Manhattan, the Hell Gate in the Bronx, and the Huntley in Buffalo."

If an atom or H-bomb were dropped on New York City or Buffalo perhaps power from the smaller source on the St. Lawrence would prove a standby of value. And then we don't seem to know just what the coal miners will do next. It is conceivable that if we can't find some economically feasible way to produce a dependable continuous supply of coal, our steam plants will be less economical to operate than water power.

New York State is a heavy importer of coal and fuel for its steam plants. What insurance does industry in the state have against the contingency of a coal strike even worse than we have had? The railroads recognize the danger; they are changing to diesel-oil-burning locomotives. Why shouldn't industry and agriculture and the general consumer try to protect themselves to whatever degree they can by adding a dependable hydroelectric plant here and there where nature has provided a favorable location with power and population, present and potential demand, in close proximity.

Mr. Murrow says, "No adequate cost estimate has as yet been made of a transmission system ... involved in making delivery to distant and nearby points." Having used the word "adequate" Mr. Murrow may be right, but estimates have been made, and the results included in the estimated cost to the consumer in mills per kilowatt-hour. There is a transmission line from Massena to Taylorville, N. Y., built during the war and now held as war-surplus property by the General Service Administration—War Assets. The estimated cost per kilowatt-hour to the consumer includes transmission costs. To the extent that new customers are to be served, the transmission from steam plants will cost just as much as from water power plants.

Again the author states, "Any fair comparison of costs should charge the hydro project with the taxes that an ordinary public-utility corporation would have to pay, because avoidance of taxes is just as much a subsidy as is the capital investment." Most engineers and economists agree that payment of taxes by government-owned utilities would be fairer to free enterprise and would promote greater efficiency all around. Let's work for that goal, but in the meantime let's recognize that at present we do not do it that way, and the fact that we do not, is no excuse for letting good power go to waste.

Neither the government of New York State nor that of the United States is being asked to finance the capital cost of the power plant, nor any of the other capital costs such as necessary dams, dikes, and dredging. The present proposal is to finance the complete power project by issuance of bonds secured by liens upon the property or the revenue from the contracts held by the Power Authority of New York. None of the obligations of the Power Authority are to be obligations of the state.

As of the moment the two agencies—the Power Authority of New York and the Hydro-Electric Power Commission of Ontario—are proposing the power project idea as an alternative to the dual project plan submitted to Congress for approval in 1941. Approval of this plan will give a pretty clear-cut idea as to the proper allocation of cost of power and navigation. The financing plan will have some resemblance to that obtaining in private enterprise, since the bonds will bear 3 percent interest and the project will be self-amortizing. Interest and sinking fund will come out of earnings, as in the case of all privately owned public utilities, and of

(*Continued on page 74*)

ASCE Hydraulics Division Meeting

with

21st Annual Meeting of Mid-South Section

Hotel Heidelberg—Jackson, Mississippi—November 1, 2, 3, 1950

Theme: What's New in Hydraulics

ALL SESSIONS WILL BE HELD IN THE HOTEL HEIDELBERG

Registration in Victory Lounge

4:00—10:00 p.m., Tuesday, October 31
8:30 a.m., Wednesday, November 1

Ice-Breaker Party—Tuesday Evening, Oct. 31

7:00—10:30 p.m. Ice Breaker Party in Victory Foyer

First Session, Wednesday Morning, Nov. 1

IN VICTORY ROOM

Presiding: H. S. Gladfelter, President, Mid-South Section and Albert S. Fry, Chairman, Hydraulics Division

10:00 Welcome by

H. S. GLADFELTER, President, Mid-South Section, ASCE.

Address of Welcome

GOVERNOR FIELDING L. WRIGHT, of Mississippi

10:30 a.m. Opening of Technical Session

ALBERT S. FRY, Chairman, Hydraulics Division.

10:35 Symposium: Making Hydraulic Data More Available to Engineers

(1) Modern Machine Methods in Data Processing (including demonstration of punched-card utilization)

MERRILL BERNARD, M. ASCE, Chief, Climatological and Hydrological Services, U.S. Weather Bureau, Washington, D.C.

(2) New Concepts for Stream Flow Data

J. V. B. WELLS, M. ASCE, Chief, Surface Water Branch, U.S. Geological Survey, Washington, D.C.

Discussion from floor

11:30 New Electronic Router for Stream Flow

MAX A. KOHLER, Assoc. M. ASCE, Chief, Procedure Development Section, U.S. Weather Bureau, Washington, D.C.

Discussion

ALFRED J. COOPER, Assoc. M. ASCE, Hydraulic Engineer, Tennessee Valley Authority, Knoxville, Tenn.

Discussion from floor

12:00 Report of Nominating Committee, Mid-South Section

12:30 Luncheon on Heidelberg Roof

In charge of Mid-South Section.

Second Session—Wednesday Afternoon, Nov. 1

IN VICTORY ROOM

Presiding: George R. Schneider, Vice-Chairman, Hydraulics Division

2:00 Hydraulic Models: One Basis for Development of Design Criteria

F. R. BROWN, M. ASCE, Chief, Hydrodynamics Branch, U.S. Waterways Experiment Station, Vicksburg, Miss.

Discussion

JACOB H. DOUMA, Assoc. M. ASCE, Hydraulic Engineer, Engineering Division, Office, Chief of Engineers, War Department, Washington, D.C.

HAROLD M. MARTIN, Assoc. M. ASCE, Chief, Hydraulic Laboratory, U.S. Bureau of Reclamation, Denver, Colo.

Discussion from floor

3:15 Model Studies for Increasing Stability of 20-Year Old Bartletts' Ferry Dam in Georgia

CARL E. KINDSVATER, Assoc. M. ASCE, Professor of Civil Engineering, Georgia Institute of Technology, Atlanta, Ga., and E. S. Harrison, Engineer, Georgia Power Company, Atlanta, Ga.

Discussion

G. H. HICKOX, M. ASCE, Associate Director, Engineering Experiment Station, University of Tennessee, Knoxville, Tenn.

Discussion from floor

4:15 Hydraulic Characteristics of Howell-Bunger Valves and Their Associated Structures (with moving pictures)

(1) Discharge Characteristics

REX A. ELDER, Assoc. M. ASCE, Head, Hydraulic Laboratory, Tennessee Valley Authority, Norris, Tenn.

(2) Air Demand Characteristics

GALE B. DOUGHERTY, Jun. M. ASCE, Engineer, Hydraulic Laboratory, Tennessee Valley Authority, Norris, Tenn.

Discussion

GEORGE A. JESSOP, Assoc. M. ASCE, Consultant, S. Morgan Smith Co., York, Pa.

Discussion from floor

Hydraulics Division Banquet

Wednesday, 7:00 p.m.—VICTORY ROOM

Toastmaster:

DEAN M. P. O'BRIEN, Member, Executive Committee, Hydraulics Division.

Greetings from the Society:

ERNEST E. HOWARD, President ASCE.

Looking Ahead:

GAIL A. HATHAWAY, President-Elect ASCE.

Presentation of other Society officers

Principal Address: "Hydraulic Engineering Memories," by DR. BORIS BAKHMETEFF, Hon. M. ASCE, Professor, Columbia University, New York, N.Y.

Third Session—Thursday Morning, Nov. 2

IN VICTORY ROOM

Presiding: Dr. Arthur Ippen, Chairman, Fluid Mechanics Committee

9:00 Symposium: Use of Analog Computers and Experiments to Study Hydrodynamic Problems in Civil Engineering

(1) Application of the Electrical Analogy to Hydrodynamics Problems in Three Dimensions

P. G. HUBBARD, Iowa Institute of Hydraulic Research, Iowa City, Iowa.

(2) Electrical Analogies and Electronic Computers for Surge and Water Hammer Problems

H. M. PAYNTER, Jun. M. ASCE, Civil Engineering Department, Mass. Inst. of Technology, Boston, Mass.

(3) Study of Pipe Networks by Means of an Electrical Network Analyzer

M. S. MCILROY, Cornell University, Ithaca, N.Y.

(4) Application of Electric Analog Studies to Specific Problems in Civil Engineering Hydraulics

F. B. CAMPBELL, M. ASCE, P. T. BENNETT, M. ASCE, and S. F. GIERINSKI, Jun. M. ASCE; Corps of Engineers, War Department, Omaha District, Omaha, Neb.

(5) Application of Analog Computers to Hydraulic Problems of Sacramento–San Joaquin Delta in California

R. E. GLOVER, M. ASCE, Research Engineer, U.S. Bureau of Reclamation, Denver, Colo.

Discussion from floor

Fourth Session—Thursday Afternoon, Nov. 2

IN VICTORY ROOM

Presiding: Dr. Lorenz G. Straub, Member, Executive Committee, Hydraulics Division

2:00 New Methods of Peak Stream Flow Determinations (with special stereoscopic slides in color)

J. M. TERRY, Assoc. M. ASCE, Hydraulic Engineer, Surface Water Branch, U.S. Geological Survey, Chattanooga, Tenn.

Discussion

SETH D. BREEDING, Assoc. M. ASCE, Hydraulic Engineer, Surface Water Branch, U.S. Geological Survey, Austin, Tex.

Discussion from floor

2:40 Flood Records and the Design of Bridge Waterways

M. T. THOMSON, Assoc. M. ASCE, District Engineer, and C. M. BUNCH, Hydraulic Engineer, Surface Water Branch, U.S. Geological Survey, Atlanta, Ga.

Discussion

CARL F. IZZARD, Assoc. M. ASCE, Highway Research Engineer, Bureau of Public Roads, Washington, D.C.

Discussion from floor

3:20 Role of Hydrology in Engineering

S. W. JENS, M. ASCE, Horner and Shifrin, St. Louis, Mo., and Chairman, Committee on Hydrology.

Discussion

DON JOHNSTONE, Assoc. M. ASCE, Engineer, Atomic Energy Commission, Los Alamos, N.Mex.

ADOLPH F. MEYER, M. ASCE, Consulting Hydraulic Engineer, Minneapolis, Minn.

Discussion from floor

4:15 Educational Facilities for Hydrology

ARNO T. LENZ, Assoc. M. ASCE, Professor, Civil Engineering, University of Wisconsin, Madison, Wis.

Discussion

DONALD BAKER, M. ASCE, Consulting Engineer, Los Angeles, Calif.

Discussion from floor

RAY K. LINSLEY, Assoc. M. ASCE, Professor, Dept. of Civil Eng., Stanford University, Stanford, Calif.

Smoker—Thursday

IN VICTORY FOYER

7:00 p.m. Buffet Dinner

Program arranged by Mid-South Section.

Inspection Trip—Friday, Nov. 3

Inspection Trip to U.S. Waterways Experiment Station, Corps of Engineers

8:30 a.m.	Leave Heidelberg Hotel
9:00 a.m.	Inspect Mississippi River Basin Outdoor Model (Also Concrete Research Division, if desired)
12:30 p.m.	Lunch in Vicksburg, Miss.
2:00 p.m.	Inspect projects of hydraulic interest at Waterways Experiment Station
5:30 p.m.	Return to Hotel

The final day of the joint meeting will be devoted to an inspection of the facilities of the laboratories of the Waterways Experiment Station at Vicksburg and Jackson, Miss. Transportation by bus and private cars will be arranged by the local Excursion Committee.

The Experiment Station is an investigative agency of the Corps of Engineers, U.S. Army, assisting in the planning for much of the civil works construction program of the Corps and in the development of design criteria and techniques applicable to certain phases of military engineering.

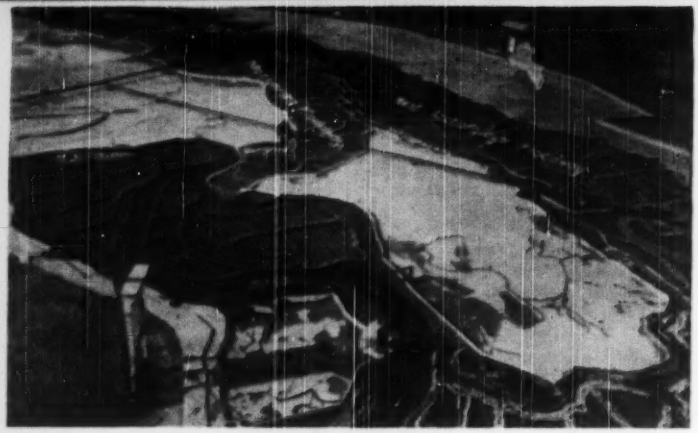
The Station was established in 1929 as a hydraulics laboratory to assist the Missis-

U. S. WATERWAYS EXPERIMENT STATION of Corps of Engineers is seen in airview looking northwest.

sippi River Commission in its program of flood control and regulation of the Mississippi River and tributaries. Subsequently the Station's activities have expanded to include in addition the fields of soil mechanics, flexible pavement, and concrete research. In August 1949 the Station was placed under the direct supervision of the Office, Chief of Engineers, and assigned the principal missions of exercising technical supervision over all hydraulic model investigations, regardless of where performed, and over such soils and concrete investigations as are directed by the Chief of Engineers, and to coordinate all such studies to the end that Corps of Engineers' civil works experimental facilities are effectively utilized.

The Experiment Station consists of two reservations: the original installation at Vicksburg, and a more recently-acquired tract 40 miles east of Vicksburg near Jackson. The Vicksburg reservation is about 500 acres in area, and here are located the main administrative headquarters, the major portion of the Hydraulics Division, the Soils Division, and the Research Center. The Jackson reservation occupies about 820 acres. It was acquired in 1943 as the site for the large model of the Mississippi River Basin; the Concrete Research Division is also at Jackson.

Transportation by bus and private cars will be arranged from the hotel in Jackson to the Jackson Sub-Office. On the morning of November 3, an inspection will be made of the Mississippi Basin Model or an alternate tour of the Concrete Research Division. Reaches of the Missouri, Mississippi, and Arkansas Rivers have been constructed to a horizontal scale of 1:2,000, and a vertical scale of 1:100. Portions of each stream have been verified and are now in operation. The model is used for flood control and reservoir operation studies.



LOWER SECTION of Mississippi River flood control model shows Morganza and West Atchafalaya Floodways in operation. Model, at U. S. Waterways Experiment Station, Vicksburg, will be visited in course of inspection trip on Friday, November 3.

The Concrete Research Division supervises all research activities of the Corps of Engineers pertaining to concrete and also serves as the laboratory for the Lower Mississippi Valley Division and the Mississippi River Commission. Investigations are made of the quality of aggregate, methods of processing ledge rock for the production of aggregate, and tests of the concrete produced by the use of a specific aggregate.

Following the morning inspection trip, the group will proceed by bus and private cars to Vicksburg and have lunch at the Vicksburg Hotel. In the afternoon an inspection will be made of the Hydraulics Division of the Waterways Experiment Station or alternate tour of the Soils Division. Model studies conducted by the Hydraulics Division at the Vicksburg laboratories include investigations of design and performance of hydraulic structures, determination of the best designs for breakdwaters, studies of the improvement of tidal estuaries, and the development of flood control and navigation-benefit plans for inland waterways.

The Soils Division acts as the Division Laboratory for the Lower Mississippi Valley Division and the Mississippi River Commission and also conducts research studies for the Office, Chief of Engineers. The work of the Soils Division includes geological and field soils studies, testing, analysis, and design of earth foundations and earthen structures, and soil mechanics research; and the development of criteria and methods for design and construction of flexible pavements.

On completion of the inspection trip at Vicksburg, the group will return to Jackson by bus and private cars.

Hotel Accommodations

Make Reservations Early

The Hotel Heidelberg, Jackson, Miss., is the headquarters for the joint meeting. All meeting activities prior to the inspection tour on the last day will be conducted at this hotel.

All those planning to attend the meeting are urged to make requests for room reservations as early as possible. Late requests, or those making specific requests for other accommodations, will be assigned space in nearby hotels.

Send all requests for reservations to:

Miss M. S. Petersen, Secretary
Jackson Branch, Mid-South Section, ASCE
P. O. Drawer 2131
Jackson, Mississippi

Registration and Information

A registration and information desk will be maintained in the Victory Lounge on the mezzanine of the Hotel Heidelberg from 4:00 p.m., October 31, until the morning of November 3. Mail and messages for members will be held here.

A special request form is printed on page 73 of this issue for your convenience.

Unaccompanied delegates should indicate whether they will share double rooms with twin beds.

Hotel Rates per Day

(All rooms with bath)

	One Person	Two Persons
Hotel Heidelberg		
Single	$3.00-$5.00	
Double		$4.50-$7.00
Double (twin beds)		6.50-8.00
Edwards Hotel		
Single	3.00-4.50	
Double		4.50-5.50
Double (twin beds)		6.00-6.50
Walthall Hotel		
Single	3.00-4.00	
Double		4.00-5.50
Double (twin beds)		5.50-7.00
Robert E. Lee Hotel		
Single	3.00-4.00	
Double		4.50
Double (twin beds)		5.00-6.00

Ladies Program

The Ladies Committee of the Mid-South Section is arranging a most interesting program. Special plans are being made so that the ladies will enjoy the hospitality of the Deep South during their stay in Jackson.

Exhibits and Demonstrations

Special exhibits will be a feature of the meeting and will display modern hydraulic equipment and other matters of hydraulic interest. A unique demonstration will be given by the U.S. Weather Bureau of the processing of hydraulic data by means of punch-card equipment.

Committees

SYDNEY W. CHANDLER, *General Chairman*
JOSEPH B. TIFFANY, *Vice Chairman*

Committee	Chairman	Vice Chairman
Entertainment	John E. Hall	Frank S. Hill
Excursions	Henry C. McGee	Camile H. Lefeve
Finance	Herbert H. Lester	Irene R. Miller
Hotel and Registration	Margaret S. Petersen	Walter E. Best
Publicity	Boyce H. Biggers	James E. Sanders
Reception	William W. Aydelott	Norman R. Moore, Willard J. Turnbull
Student Activities	Irving E. Anderson	Charles R. Foster
Technical Program Assistance	Karl A. Dupes	Howard G. Scott
Women's Activities	Mrs. S. W. Chandler	Mrs. N. R. Moore

SOCIETY NEWS

Society Elects Nine New Officers for 1951

IN THE FIRST ASCE election since adoption of the new Constitution, the Society has elected a President, two Vice-Presidents, and six Directors. The results of the balloting are given in the Tellers' Report on page 54. For the first time, the Directors and Vice-Presidents were elected by the voters in their respective Districts and Zones instead of by the Society as a whole. The new officers will be introduced at the Society's forthcoming Chicago meeting in October and will assume office in January.

A biographical sketch of Gail Hathaway, newly elected President of the Society and Special Assistant to the Chief of Engineers, Department of the Army, Washington, D.C., appeared in the July issue, following his nomination for the presidency. Brief biographical data on the other new officers are given here.

William R. Glidden

An authority on bridge design and construction, William R. Glidden, newly elected Vice-President for Zone II, has been bridge engineer for the Virginia State Highway Department at Richmond since 1917. In this position and through membership on various technical committees, he has contributed to the evolution of highway bridge engineering. A graduate of Massachusetts Institute of Technology, Mr. Glidden for many years was on the engineering faculty of the Virginia Mechanics Institute and has taught special classes under the auspices of the Virginia Polytechnic Institute and the University of Virginia.

Mr. Glidden has been a member of the Society since 1922 and was Director from 1946 to 1949. Long active in the Virginia Section, he has been on its board of directors and was president for a year.

Daniel V. Terrell

Daniel V. Terrell, Vice-President for Zone III, is dean of the College of Engineering and director of the Kentucky Engineering Experiment Station at the University of Kentucky, Lexington. A graduate of the university, he has served it continuously since 1912 and has been dean of engineering since 1946. He has been active in research and testing of engineering materials and the development of highway engineering. As early as 1914 he established and conducted road conferences at the University of Kentucky and developed a plan for state aid to counties, which formed a lasting foundation for the Kentucky Highway Department. For more than twenty years he has been a research consultant for the Department and at present is director of research for it.

A Member of ASCE since 1926, Dean Terrell was instrumental in establishing the Kentucky Section and served as its president in 1938. He was also responsible for originating, at the University of Kentucky, one of the earliest Student Chapters. As ASCE Director from 1947 to 1950, he planned and directed formation of the District 9 Council.

Kirby Smith

Kirby Smith, Director for District 1, is vice-president of the Raymond Concrete Pile Co., New York City. He is a graduate of the U.S. Naval Academy and Rensselaer Polytechnic Institute, with an early career in the Navy. He has been with the Raymond Concrete Pile Co. since 1925, except for a four-year period of Naval service in World War II. His wartime service included assignments as project manager in charge of all Navy yards, and as director of all continental construction for the Bureau of Yards and Docks.

A construction expert, Mr. Smith has served as chairman of the Executive Committee of the ASCE Construction Division. He has been a member of the Society since 1920 and is already on the Board of Direction, having been appointed to replace Edmund A. Prentis, who resigned because of ill health. As Director he is serving on the ASCE–AGC Joint Cooperative Committee.

Francis S. Friel

The newly elected Director for District 4, Francis S. Friel, has been on the Board of Direction since March, filling the unexpired term of the late Joel Justin. President and treasurer of the Philadelphia consulting firm of Albright & Friel, Inc., Mr. Friel has been in consulting practice for 28 years and has directed the engineering staff of Albright & Friel since 1931. Major projects he has directed include water supplies for Chester, Pa., and Winston-Salem, N.C., and sewage facilities for Philadelphia. An authority in the sewerage field, he has been president of the Federation of Sewage Works Associations.

Mr. Friel is a graduate of Drexel Institute and a veteran of World War I, having served as an Engineer officer with the A.E.F. in France. During the recent

WILLIAM R. GLIDDEN
Vice-President, Zone II

DANIEL V. TERRELL
Vice-President, Zone III

KIRBY SMITH
Director, District 1

FRANCIS S. FRIEL
Director, District 4

MILTON T. WILSON
Director, District 11

WALLACE L. CHADWICK
Director, District 11

NORMAN R. MOORE
Director, District 14

BURTON G. DWYRE
Director, District 15

war he directed the engineering work on 19 war projects. A member of the ACSE since 1926, Mr. Friel has served the Philadelphia Section as director, vice-president, and president for two terms.

Milton T. Wilson

An authority in the field of water resources investigations, Milton T. Wilson, one of two new Directors for District 11, has spent most of his professional career with the Water Resources Division of the U.S. Geological Survey. He is now district engineer at Salt Lake City, Utah. Mr. Wilson is author of several water-supply papers for the Colorado, Columbia, and Great Basins, and was responsible for much of the hydrologic information used by Utah in development of the Upper Colorado River Compact and its many projects. He is an alumnus of Utah State Agricultural College.

Becoming an Associate Member of ASCE in 1933 and Member in 1947, Mr. Wilson has been secretary, treasurer and president of the Intermountain Section. With other engineers, he was instrumental in forming the Utah Engineering Committee, forerunner to the recently established Utah Engineering Council. At present Mr. Wilson represents civil engineers on the executive board of the Council.

Wallace L. Chadwick

Wallace L. Chadwick, manager of the engineering department of the Southern California Edison Co., Los Angeles, is the other new Director for District 11. Educated at the University of Redlands and a veteran of World War I, Mr. Chadwick was with the Southern California Edison Co. from 1922 to 1931 and with the Metropolitan Water District of Southern California from the latter year to 1937. Rejoining the Southern California Edison Co., he has been manager of the engineering department since 1945, directing engineering and construction. Among its large jobs are the 280,000-kw steam station at Redondo, Calif., and the Big Creek No. 4 plant now nearing completion.

A Member of ASCE since 1937, Mr. Chadwick has filled numerous committee assignments and has been president of the Los Angeles Section. At present he is on the executive committee of the Power Division. As president of the Los Angeles Engineering Council in 1947, he conducted a successful campaign to broaden the California registration law to include other professional engineers.

Norman R. Moore

A specialist in flood control, navigation, and power, Norman R. Moore, Director for District 14, has been connected with the Army Corps of Engineers since 1934. As chief of the Engineering Division of the Vicksburg District during the early war years, he was responsible for the planning and design of a $200 million military construction program. Since 1943 he has been in the Office of the President, Mississippi River Commission, and Division Engineer, Lower Mississippi Valley Division, where he is chief of the Engineering Division. He is an alumnus of the University of Minnesota.

A Member of ASCE since 1938, Mr. Moore is a past-president and former director of the Mid-South Section and helped form the Vicksburg and Jackson Branches of the Section. He was instrumental in securing adoption by the City of Vicksburg of its first building and zoning ordinance, and helped prepare the Building Code and Zoning Ordinance. He is chairman of the Board of Zoning Appeals.

Burton G. Dwyre

Burton G. Dwyre, New Mexico State Highway Engineer, Santa Fe, N. Mex., is new Director for District 15. An authority in the highway engineering field, Mr. Dwyre was with the New Mexico State Highway Department from 1920 to 1925. After a ten-year interruption for work as county engineer and surveyor for Grant County, city engineer of Silver City, and U.S. Mineral Surveyor for the District of New Mexico, he returned to the Department in 1935. He was state highway engineer from 1939 to 1943 and has held the position continuously since 1946.

Becoming an Associate Member of the Society in 1930 and Member in 1940, Mr. Dwyre is a past-president of the New Mexico Section. He has also been president of the Western Association of State Highway Officials and active on the New Mexico Board of Registration for Professional Engineers and Land Surveyors.

ASCE Prizes to Be Awarded at Chicago Meeting

PRESENTATION OF ASCE prizes and medals for papers in Volume 114 of TRANSACTIONS (1949) will be made at the opening session of the Chicago Meeting on October 11. The Construction Engineering Prize differs from the others in being specifically limited to material appearing in CIVIL ENGINEERING. Descriptions of the various awards are given on page 80 of the Official Register for 1950.

Highlights in the careers of those receiving prizes and medals follow.

Friedrich Bleich

Noted as a structural engineer, author, and research worker, Friedrich Bleich, M. ASCE, posthumous winner of the Norman Medal for his paper on "Dynamic Instability of Truss-Stiffened Suspension Bridges Under Wind Action," was born in Vienna and educated at the Austrian Technical University. Before coming to the United States in 1941, he was engaged in the design of bridges, large

FRIEDRICH BLEICH
Norman Medal

L. F. HARZA
J. James R. Croes Medal

R. N. BERGENDOFF

JOSEF SORKIN
Winners of Thomas Fitch Rowland Prize

industrial plants, and other structures in Vienna and Zurich, Switzerland. From 1944 to 1947 did research on the causes of the Tacoma Narrows Bridge disaster for the Advisory Board on Investigation of Suspension Bridges. The present prize-winning paper is based on this research. Associated with the New York consulting firm of Frankland & Lienhard since 1947, Mr. Bleich was completing a survey on the buckling strength of metal structures for the U.S. Navy at the time of his death.

L. F. Harza

L. F. Harza, M. ASCE, Chicago consultant, receives the J. James R. Croes Medal for his paper, entitled "The Significance of Pore Pressure in Hydraulic Structures." President of the Harza Engineering Co., Mr. Harza has been in independent practice since 1912, with offices in Chicago since 1916. He is an alumnus of South Dakota State College and holds graduate degrees from the University of Wisconsin. A specialist in hydroelectric power developments, flood control projects, dams, and allied hydraulic engineering, Mr. Harza has been designing engineer for Dix Dam in Kentucky; the Loup River Public Power District of Nebraska; the Santee-Cooper hydroelectric power project in South Carolina; the Rio Negro Development in Uruguay; the Fort Peck Powerhouse; and a number of other powerhouses for the Corps of Engineers.

Ruben N. Bergendoff and Josef Sorkin

The Thomas Fitch Rowland Prize goes to Ruben N. Bergendoff and Josef Sorkin, Members ASCE, for their paper entitled "Mississippi River Bridge at Dubuque, Iowa."

A graduate of the University of Pennsylvania, Mr. Bergendoff has been with Howard, Needles, Tammen, and Bergendoff, Kansas City, Mo., and its predecessor firms since 1922, except for a year as bridge designer for the Montana State Highway Commission. He was admitted to partnership in the firm in 1940. Mr. Bergendoff has actively participated in the design of nine Mississippi River bridges, including the Dubuque Bridge. In recent years he has been engaged on the design of the Maine Turnpike and the Denver-Boulder Turnpike as well as expressway systems in Toledo and Akron, Ohio, and Kansas City, Mo.

Mr. Sorkin has been associated with Howard, Needles, Tammen & Bergendoff since 1939—from 1941 to 1943 as office engineer in charge of the design of war-plants, including the Southwest Proving Ground in Arkansas and the Blue-bonnet Ordnance Plant in Texas, and from 1943 to 1950 as chief design engineer in the Kansas City office of the firm. He was admitted to partnership on January 1, 1950. Earlier he was bridge designer for the Montana State Highway Commission and assistant chief design engineer for the Central Nebraska Public Power and Irrigation District at Hastings. A Russian by birth, Mr. Sorkin has been in the United States since 1923 and a citizen since 1930. He holds several degrees from the University of Nebraska.

Harris G. Epstein

The late Harris G. Epstein is recipient of the James Laurie Prize for his paper, "Application of Test Results to Quay Wall Design." Widely known for his research in structural engineering, Mr. Epstein was with the Navy Bureau of Yards and Docks from 1917 until his death on February 20, 1950. As chief of the Waterfront Structures Section, he designed piers, quay walls, and graving docks at many of the Navy's principal installations. These installations included the graving docks at Pearl Harbor for salvage of the fleet damaged by the Japanese; graving docks at Mare Island

HARRIS EPSTEIN
James Laurie Prize

A. A. ANDERSON
Arthur M. Wellington Prize

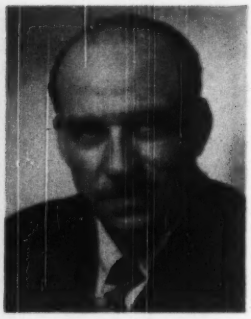
C. A. LEE

C. E. BOWERS
Winners of Collingwood Prize for Juniors

WILLIAM ALLAN
J. C. Stevens Award

N. M. NEWMARK
Leon S. Moisseiff Award

ROBERT E. TURNER
James W. Rickey Medal



W. C. MASON
Construction Engineering Prize

ard Terminal Island, Calif., and at Puget Sound, Wash.; the breakwater at Guam; and the foundations for the Navy's 450-ton crane at Hunter's Point, San Francisco Bay. Mr. Epstein was a graduate of City College of New York.

A. A. Anderson

A. A. Anderson, Assoc. M. ASCE, winner of the Arthur M. Wellington Prize for his paper on "Expansion Joint Practice in Highway Construction," has been with the Portland Cement Association for the past 27 years. As manager of the Highways and Municipal Bureau since 1936, he has directed the Association's highway work throughout the United States. A graduate of Kansas State College, Mr. Anderson was division engineer of the Kansas State Highway Commission before going to the Portland Cement Association. He is author of several technical articles and booklets on concrete pavements.

Charles A. Lee and Charles E. Bowers

Winners of the Collingwood Prize for Juniors are Charles A. Lee and Charles E. Bowers, Junior Members ASCE, for a paper on "Ship Performance in Restricted Channels."

Mr. Lee received his bachelor degree in civil engineering from the University of Wyoming and his master's degree from Lehigh University, where he specialized in hydraulics. From 1940 to 1942 he was hydraulic engineer for the Navy Department's David Taylor Model Basin, Washington, D.C.; from 1942 to 1946, a commissioned officer in the Navy Civil Engineer Corps; and from 1946 to 1948, in charge of hydraulic studies at the Taylor Model Basin. Since the latter year he has been hydraulic engineer for the Kimberly-Clark Corp. at Neenah, Wis.

Mr. Bowers was at the Taylor Model Basin from his graduation from the University of Wyoming in 1942 until 1947—part of the time as an ensign in the Naval Reserve. While attached to the Basin, he was engaged in the development of facilities and equipment used in the testing of ship models and underwater ordnance, and in various experimental studies. The latter included an investigation of ship performance in restricted channels, the results of which are described in the prize-winning paper. In 1947 he was awarded the Standard Oil Fellowship in Hydraulics at the University of Minnesota, from which he received an M.S. degree in civil engineering in 1949. At present he is a hydraulic engineer for the Bureau of Reclamation.

William Allan

William Allan, M. ASCE, winner of the J. C. Stevens Award for his discussion of the paper, "Panama Canal—The Sea-Level Project: a Symposium," is professor of civil engineering and dean of the School of Technology of the City College of New York. Co-winner two years ago of the Norman Medal, Dean Allan has had a distinguished career as an engineering educator and in hydraulics research. Holder of both bachelor and master's degrees in civil engineering from the Polytechnic Institute of Brooklyn, Dean Allan has been at City College since 1933 and has been professor of civil engineering and dean of the Technology School since 1947. He has served as engineering consultant on a number of hydraulics projects and is author of various works on fluid mechanics.

Nathan M. Newmark

An authority in the structural engineering field, Nathan M. Newmark, M. ASCE, winner of the Moisseiff Award for a paper on "Design of I-Beam Bridges," has been on the University of Illinois engineering staff since 1934 except for a period of war service. He graduated from Rutgers University, and received the degrees of master of science and doctor of philosophy in engineering from the University of Illinois. He is now in charge of the research program in structural engineering in the Engineering Experiment Station there. During World War II he was engaged in a number of activities here and abroad through the National Defense Research Committee and the Office of Scientific Research and Development, and later was with the Scientific Advisory Group of the U.S. Air Force. Author of a number of structural papers, Professor Newmark won the Society's J. James R. Croes Medal in 1944.

Robert E. Turner

The James W. Rickey Medal goes to Robert E. Turner, M. ASCE, hydrographer for the Susquehanna Electric Co. at Conowingo, Md., for his paper on "Operation of the Conowingo Hydroelectric Plant." Mr. Turner has been continuously employed by the Philadelphia Electric Co. and its subsidiary companies in the design, construction, and operation of the Conowingo Hydroelectric Development since its inception in 1926. In his work he has been instrumental in bringing about a cooperative agreement, whereby the various governmental agencies concerned with stream flow, with the assistance of private interests, have set up a flood-forecasting service that is a model in public service. Mr. Turner is an electrical engineering graduate of Iowa State College and has done graduate work at the University of Pennsylvania and the Johns Hopkins University.

William C. Mason

The Construction Engineering Prize is awarded to William C. Mason, project engineer for the Owens River Gorge Power Project, for his paper entitled "Tunnel Records Broken at Owens River Gorge," in the April issue of CIVIL ENGINEERING. With the Los Angeles Department of Water and Power for more than twenty-five years, Mr. Mason has been in charge of field engineering for the power system on the construction of all major plant additions and extensions since 1930 and has been connected with the Gorge Project since 1942. He is a graduate of Purdue University and a veteran of World War I, with service in the Air Section of the Signal Corps.

FROM THE NATION'S *Capital*

JOSEPH H. EHLERS, M. ASCE
Field Representative, ASCE

MILITARY ACTION IN Korea culminating this week in the liberation of Seoul again holds the legislative spotlight in Washington.

Economic Controls Set Up

The economic controls mentioned last month became definite with the signing of the Defense Production Act of 1950 (P.L.774) and the issuance of Executive Order 10161 making certain delegations as provided in the Act, and regulation of the Federal Reserve Board in connection with consumer credit.

The Act comprises seven titles dealing with priorities and allocations, authority to requisition, expansion of productive capacity and supply, price and wage stabilization, settlement of labor disputes, control of consumer and real estate credit, and various general provisions.

The President is authorized to establish priorities to require the performance of defense contracts and to allocate material and facilities. The executive order delegates these functions to four agencies. Electric power, oil and fuels are handled by the Secretary of the Interior; food and farm equipment by Agriculture; domestic transportation by the Interstate Commerce Commission; and all other materials and facilities by the Secretary of Commerce. Each of these agencies makes allocations in its field and appears as a claimant before the other agencies for materials needed in its field, which are under the control of such other department.

National Production Authority

The chairman of the National Security Resources Board was named top man in the Economic Mobilization Program. Perhaps the principal burden will fall on Secretary of Commerce Sawyer. A National Production Authority has been established in the Commerce Department, headed by William H. Harrison, president of the International Telephone and Telegraph Co., member of the AIEE, and prominently identified with important EJC committees. The Authority has issued an inventory control order listing 32 products, including cement, gypsum board, certain kinds of lumber, iron and steel, copper, aluminum, rubber and various other products. The President has authority to requisition any real or personal property needed for the defense of the United States and provide for methods of reimbursement. Provision is made for the expansion of productive capacity and for the guaranteeing of financing by various government departments, as well as for direct loans, price and wage stabilization. The President may issue regulations establishing price ceilings either on single commodities or on larger groups of commodities, with the proviso that there must be simultaneous wage freezing in the affected production fields. Provision is made for the settlement of labor disputes, and control of consumer and real estate credit is authorized. The President may regulate credit on all structures commenced since August 3. Regulation W, issued by the Federal Reserve Board, implements the legislation relating to consumer credit.

Some Construction Shortages Inevitable

The civil engineering profession has some contact with production control operations through the Construction Industry Advisory Council of the United States Chamber of Commerce. At a meeting held in Washington on September 14, a subcommittee on construction mobilization was established under the chairmanship of Ralph Walker, president of the AIA, with Carlton Proctor, former Vice-President of ASCE and chairman of the EJC National Engineers Committee, serving as vice-chairman. This Construction Industry's subcommittee has met with top officials of the National Production Authority.

Although the law gives wide control powers to the Chief Executive, it is not expected that the full force of the law will be invoked unless worsening conditions make this necessary. As to the extent to which shortages of materials will affect civilian construction over the next year or more, no conclusion is possible until we know whether we are engaged only in a Korean police action or in a world-wide show of strength. Even assuming that the Korean situation is cleared up, preparedness is the order of the day and some shortages are inevitable. For example, freight cars are in short supply. Their production might be doubled or tripled on short notice. This could cause some temporary disruptions in normal civilian steel supplies. Steel sheets and plates might be in very short supply even with a minor defense demand relative to total steel production. Projects may be curtailed by the government for reasons of economy, or to conserve manpower regardless of the materials situation. The shortages of World War II should not occur in the current situation unless a wide conflict develops. New home building has already been affected by the current restrictions and will probably be more so in the next six months.

The Defense Department and the Department of Commerce will obviously play an important part in making rules for the award of engineering and construction jobs and in the awarding of such jobs. The Commerce Department, and the Army, Navy and Air Corps all have regional information and procurement offices where firms seeking work should go prior to coming to Washington, D.C.

ASCE MEMBERSHIP AS OF SEPTEMBER 9, 1950

Members	7,743
Associate Members	9,966
Junior Members	12,014
Affiliates	72
Honorary Members	39
Fellows	1
Total	29,835
(September 9, 1949	26,701)

District of Columbia Registration Bill Signed

After prolonged hearings and discussions, the bill providing for registration of engineers in the District of Columbia, passed both Houses of Congress (S.3555) and was signed by the President on September 19 as P.L.789. Details of this will be given next month.

Public Law 776, signed in September by the President, "provides for the dissemination of technological, scientific, and engineering information to American business and industry." This activity will center in the Department of Commerce.

Central Arizona Project Bill

The controversial $600 million Central Arizona reclamation project bill (S.75), passed by the Senate earlier this year, has been under consideration by the House Public Lands Committee. This Committee has decided to take no action on it.

The Senate has passed a bill to provide $120 million for emergency war housing. This now goes to the House.

Appointments to NSFB Held Up

Work under the National Science Foundation Act (P.L.507) is held up pending approval of an appropriation for its work. It has been rumored that this delay has been due to proposals to reestablish the war research agencies. Actually the law makes it possible for the National Science Foundation to handle all necessary defense research. The appointment of the members of the NSFB is held up probably awaiting approval of the appropriation.

EJC Acts on Engineering Manpower

The meeting of Engineers Joint Council in New York on September 15 brought out matters of interest relating to the Washington scene. The establishment of the Engineering Manpower Commission by EJC to deal with placements and deferments of engineers is a matter of profound importance to the profession and demonstrates the growing faith of the government in EJC as the group through which the engineering profession acts. This is dealt with in detail elsewhere in this issue. The meeting also showed increased activity on the part of the EJC Committee on International Relations, including the establishment of a subcommittee on the Far East.

The EJC Committee on Engineers in Civil Service reported to the Council that it had successfully carried out the mandate of Council "... to foster the establishment of an Advisory Committee to the U.S. Civil Service Commission." Such a Committee has now been established by the government (See CIVIL ENGINEERING for September), and it should be in a position to make a vital contribution to governmental personnel policies as they affect engineers. The EJC Committee reported that it would continue its efforts to improve further the handling of Civil Service problems that come to its attention.

Congress has recessed, subject to call should the military situation require it.

Washington, D.C.
September 26, 1950

Engineering Manpower Commission Is Established by EJC

ENGINEERS JOINT COUNCIL has established an Engineering Manpower Commission to make recommendations for procedures that will assure to the nation the most effective utilization of engineers in the national defense effort. This unanimous action was taken at an EJC meeting on September 15, in response to a request from the Manpower Office of the National Security Resources Board. The new Commission, headed by E. G. Bailey, past-president of ASME and vice-president of the Babcock & Wilcox Co., New York, is to consist of 18 other men, three each from the five constituent EJC organizations and three from the American Society for Engineering Education.

The new Commission is charged with the responsibility of (1) developing policies and procedures designed to secure the most effective use of engineering skills and experience in industry and government, both civilian and military, during the emergency, and (2) taking necessary steps within the scope of EJC to put such policies and procedures into practice.

The National Security Resources Board is studying a departure from traditional methods for inducting scientific and technical personnel into military service in this country. In the event of large-scale mobilization, individuals possessing such skills would be reserved from military duty and would be subject to induction into the Armed Services only on the basis of a military requisition for the specific skills in question. NSRB has also asked the Institute of Physics, the American Chemical Society, and the National Research Council (the latter with reference to scientists other than engineers, chemists, and physicists) to assist in reaching a rational decision on the merits of this highly complex mobilization problem before presentation to Congress.

In accepting the assignment of the National Security Resources Board, EJC made it "completely clear that engineers do not ask for any special concessions. They ask only for an opportunity to apply their skills where they will be of greatest use."

The Survey of Selected Engineering Personnel, recently completed by EJC for the Office of Manpower of NSRB, will be the source information from which both government agencies and war production industries can be guided to persons with essential skills.

Tellers Canvass Ballot for 1951 ASCE Officers

To the Ninety-Eighth Annual Meeting
American Society of Civil Engineers:

The Tellers appointed to count the Ballot for Officers of the Society for 1951 reports as follows:

For President:

(Term January 1951–October 1951)

Gail A. Hathaway	9,613
Scattering	19
Void	1
Blank	3

For Vice-Presidents: Zone II

(Term January 1951–October 1952)

William R. Glidden	1,398
Gerald G. Greulich	1,118
Scattering	0
Void	2
Blank	9

Zone III

(Term January 1951–October 1952)

Daniel V. Terrell	1,534
Ivan C. Crawford	1,286
Scattering	0
Void	3
Blank	17

For Directors: District 1

(Term January 1951–October 1953)

Kirby Smith	1,055
Scattering	13
Void	1
Blank	0

District 4

(Term January 1951–October 1953)

Francis S. Friel	469
Scattering	5
Void	0
Blank	0

District 11 (Two to be elected)

(Term January 1951–October 1952)

Milton T. Wilson	1,454

(Term January 1951–October 1953)

Wallace L. Chadwick	1,456
Scattering	1
Void	0
Blank	0

District 14

(Term January 1951–October 1953)

Norman R. Moore	522
Scattering	1
Void	0
Blank	0

District 15

(Term January 1951–October 1953)

Burton G. Dwyre	723
Scattering	0
Void	0
Blank	2
Ballots counted	20,705
Number of ballot envelopes received	12,251
Ballot envelopes rejected	
Without signature	103
From members in arrears of dues	4
Total envelopes rejected	107

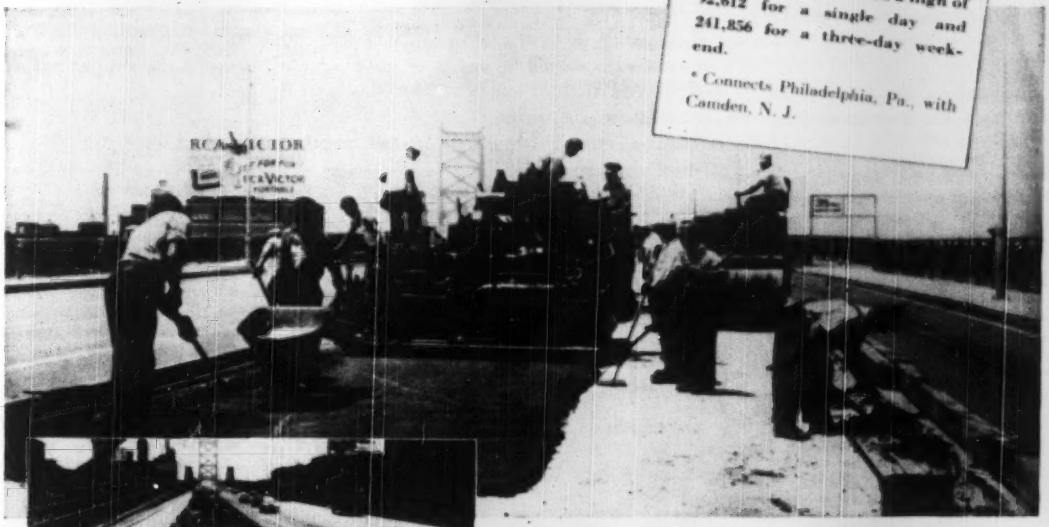
Respectfully submitted
Edward S. Sheiry, *Chairman*
R. Edward Kuhn, *Vice-Chairman*
Henry F. Boyer — Daniel J. Houlihan
Alex J. Castro — Frederick W. Ockert
Warren G. Cummings — Paul M. Wentworth
George H. Harp
(*Tellers*)

For Proceeding's Abstracts and Order Blank See Pages 95 and 96

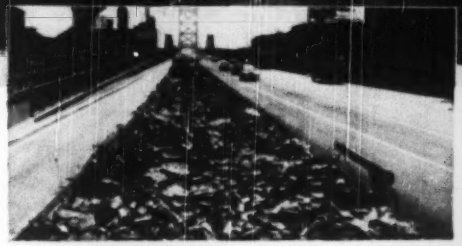
Heavy-duty pavement wanted here

26,899,212 vehicles crossed the Delaware River Bridge* last year. One out of nine vehicles was a truck or bus. Traffic over the bridge has reached a high of 92,612 for a single day and 241,856 for a three-day week-end.

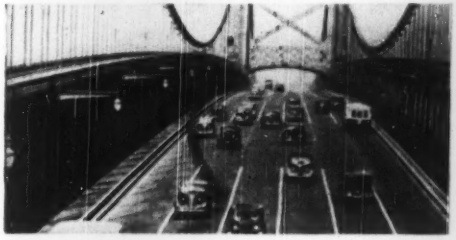
* Connects Philadelphia, Pa., with Camden, N. J.



Constructing 8-lane Texaco Asphaltic Concrete pavement on the Delaware River Bridge with minimum interference to traffic.



Old granite blocks were removed to make way for heavy-duty Texaco Asphaltic Concrete, laid by Union Paving Company, Philadelphia.



This 6-lane Texaco Asphalt pavement has been serving heavy Delaware River Bridge traffic for five years with slight maintenance.

As the above figures show, traffic on the Delaware River Bridge at Philadelphia is exceptionally heavy. Not often is a pavement called upon to withstand the severe and sustained traffic, which paving on this bridge gets day after day.

Because of the unusual traffic conditions, road builders will be interested in the use of hot-mix, hot-laid Texaco Asphaltic Concrete to pave an 8-lane section of the bridge this year. Old granite blocks were removed from a large area and replaced by two courses of resilient, heavy-duty Asphaltic Concrete, four to five inches thick.

Five years ago, another section of the Delaware River Bridge was paved with Texaco, employing both Asphaltic Concrete and Sheet Asphalt construction. This section has required virtually no maintenance. It is in excellent condition today and continues to give satisfactory service.

Wherever heavy-duty paving is required, whether for streets, highways, bridges or airports, the proven durability and low annual cost of Texaco Asphaltic Concrete merit careful consideration. For a full description of this and other asphalt types, write our nearest office for the booklet, "Texaco Asphalt Paving—Plant-mixed Types."

THE TEXAS COMPANY, Asphalt Sales Dept., 135 E. 42nd Street, New York City 17

Boston 16 Chicago 4 Denver 1 Houston 1 Jacksonville 2 Philadelphia 2 Richmond 19

TEXACO

TEXACO ASPHALT

ASCE Group Plan Offers Military Service Coverage

EXTENSION OF THE ASCE Group Disability Plan to cover insured members serving in the Armed Forces against sickness or injury having its inception in the United States or Canada south of 58° N. latitude is announced by the Continental Casualty Co., underwriters of the Society's insurance plan.

Also important to young men entering the Army is the provision in the Group Policy that members of the Armed Forces outside the stipulated geographical limitations may suspend their insurance for the period of service. They will receive credit for the full pro rata unearned premium, with the privilege of reinstatement upon return to civilian status and employment.

Many policies exclude accidents occurring or sickness contracted while in military or naval service.

Scheduled ASCE Meetings

FALL MEETING
Chicago, Ill., October 11–13
(Board of Direction meets October 9–10)

SPRING CONVENTION
Houston, Tex., February 21–23
(Board of Direction meets February 19–20)

SUMMER MEETING
Louisville, Ky., June 13–15
(Board of Direction meets June 11–12)

Coming Local Section Events

Buffalo—Meeting at the Buffalo Athletic Club, Buffalo, October 17.

Central Ohio—Dinner meeting at the Chittenden Hotel, Columbus, October 19, at 6:15 p.m.

Cincinnati—Meeting in Cincinnati on November 1.

Cleveland—Meeting at the Cleveland Engineering Society, Cleveland, October 20, at 8 p.m.; preceded by dinner at 6:30 p.m.

Kansas—Meeting at Salina, October 20, at 6:30 p.m.

Los Angeles—Dinner meeting at the Alexandria Hotel, Los Angeles, October 11, at 6:45 p.m., with Junior Forum meeting at 6 p.m. Annual ladies night dinner-dance at the Beverly-Wilshire Hotel, November 3, at 8:15 p.m.

Louisiana—Joint meeting with the Louisiana Polytechnic Institute Student Chapter on October 14.

Maryland—Meeting at the Engineers Club of Baltimore, Baltimore, October 11, at 8 p.m.; preceded by cocktails at 6:15 p.m. and dinner at 7 p.m.

Metropolitan—Meeting in the Engineering Societies Building, October 18, at 8 p.m.

North Carolina—Fall meeting at North Carolina State College, Raleigh, October 14.

Northeastern—Joint meeting with Boston Society of Civil Engineers in Boston, October 18.

Philadelphia—Meeting of Delaware Sub-Section at Hotel Rodney, Wilmington, October 17, at 8 p.m.

Pittsburgh—Meeting sponsored by the Juniors of the Section in the Duquesne Room of the William Penn Hotel, Pittsburgh, October 25, at 8 p.m.

Seattle—Dinner meeting at Engineers' Club, October 25, at 6:15 p.m.

Tennessee Valley—Fall meeting at Chattanooga, November 10 and 11.

Texas—Fall meeting in the Austin Hotel, Austin, October 19–21.

West Virginia—Fall meeting at the Wheeling Country Club (between Wheeling and Oglebay Park), October 20, at 6:30 p.m.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
District of Columbia	Sept. 14	13	William G. Hoyt, who retired after 43 years of service with the Department of the Interior, was guest of honor at luncheon of past-presidents.
Georgia	Sept. 8	40	Fred Cox, assistant director, Georgia Institute of Technology Engineering Experiment and Research Station, spoke on recent Station research. New constitution and by-laws were adopted by Section.
Kansas City	Sept. 5	74	Dinner meeting. L. V. Sorg, research chemist, Standard Oil Co., spoke on gasoline's amazing molecules.
Los Angeles	Sept. 13	40	Meeting of Junior Forum with Burton B. Most, vice-president of Forum, describing the Jordan Valley Authority Plan in Israel. Frank A. Nickell, chief consulting geologist for the State of Israel, led the discussion.
Louisiana	July 31	41	J. M. Marshall, district engineer, American Institute of Steel Construction, Atlanta, Ga., talked on "Building with Steel."
Mid-South Jackson Branch	Aug. 30	21	Dinner meeting with Stanley M. Hart, concrete research engineer, Waterways Experiment Station, reporting on an investigation of technical training courses in the area. Resolution was passed to support the extension courses sponsored by Mississippi State College.
North Carolina	Aug. 18	22	Joint business and technical meeting with North Carolina Society of Engineers. "Development of Major Appliances for the Home and the Trend for the Future" was subject of talk by J. C. Sharp, vice-president in charge of engineering, Hotpoint Inc., Chicago; and L. H. Needham, vice-president, Penetryn System Inc., of Cleveland, Ohio, spoke on renovation of concrete structures.
Oklahoma City	Sept. 15	...	Inspection trip to the Southside Sewage Treatment Plant. Speakers at the technical meeting following included Tom Sorey, of Sorey, Hill & Sorey, architects, Oklahoma City; C. O. Clark with Corps of Engineers, Tulsa; Harold Wenzel, structural engineer, Portland Cement Association; ASCE Director Webster L. Benham; and Johnston Murray, candidate for governor.
Sacramento	July 25	71	Luncheon meeting with Carl Lawrence, building contractor of Sacramento, speaking on "Modern Methods of Building Construction."
South Carolina	July 21–22	40	Joint annual meeting with the South Carolina Society of Engineers, including an inspection of the Corps of Engineers Dredge, *Gehrig*, business sessions, and a banquet.
Tacoma	Sept. 12	36	W. R. Bond, engineer, Service Bureau of American Wood Preservers Association, gave a talk on wood preservatives.
Texas Fort Worth Branch	Sept. 11	36	Dan R. Ketchum, with the Corps of Engineers, spoke on the construction of Benbrook Dam.

How to cut your overhead —underground

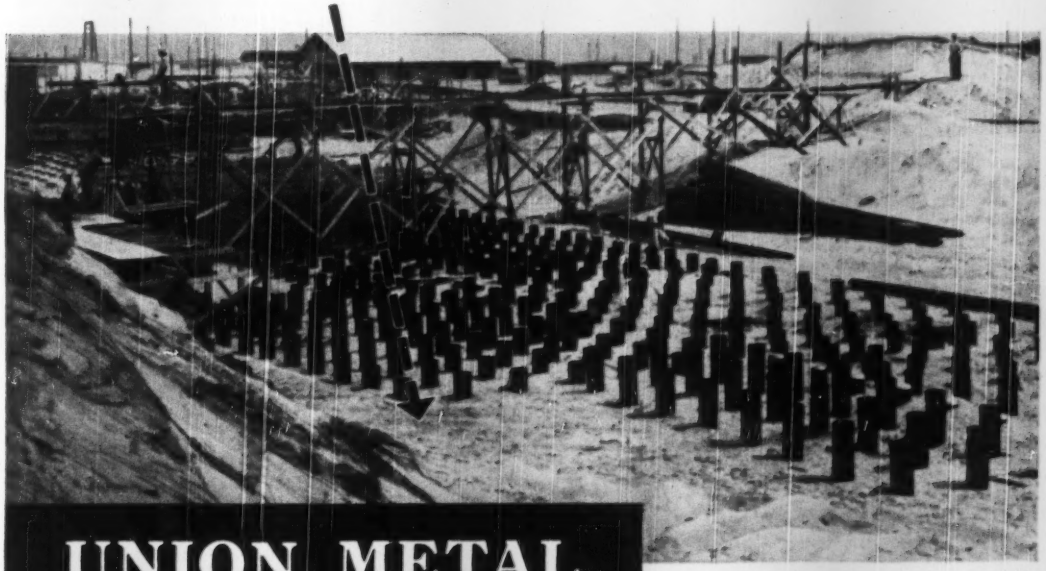
IF you think that there aren't ways of saving on foundation costs, you'll be surprised when you see what Monotube Steel Piles can do for you.

Monotubes are manufactured in 3 tapers; from a standard 8" nose they taper uniformly to any of four standard diameters, all extendible for an indefinite length to satisfy conditions known or unforeseen. Gauge of metal may be varied for any section as needed—providing economical construction. These light, sturdy tubes result in structurally sound, lasting installations. Jobs started with Monotubes can be *completed* with them—avoiding delays, complications, and undue expense.

And Monotubes are adaptable to practically any type of structure. Their fluted, cold-rolled construction adds strength and stability to resist severe driving as well as uplift, lateral and torsional forces.

Moreover, Monotubes are light in weight which simplifies and speeds handling. They require no special driving equipment. Cut-offs can be made easily, with minimum waste. These and other advantages mean foundations will *cost less* per ton of load supported.

For complete information, write The Union Metal Manufacturing Company, Canton 5, Ohio.



UNION METAL

Monotube Foundation Piles

NEWS

Four-State Compact Proposed for Development of Delaware River Basin

AN AMBITIOUS PROGRAM for development of all the water resources of the Delaware River Basin was reported at the annual meeting of the Interstate Commission on the Delaware River Basin (Incodel) at Shawnee-on-Delaware, Pa., September 11 and 12, and adopted as a basis for action by its Board of Direction. Administration of the program, which will involve construction of a series of reservoirs and tunnels at an estimated cost of $800,000,000, would be in the hands of an official body called the Delaware River Basin Commission.

Consulting engineers for Incodel—the New York firm headed by Malcolm Pirnie, Past-President ASCE, and the Philadelphia firm headed by ASCE Director Francis Friel—recommended a two-stage development to store flood waters on the upper Delaware River and its tributaries and divert them through tunnels and conduits to the metropolitan areas of New York and New Jersey and to Philadelphia.

"This is the first time," Mr. Pirnie told the group, "a survey has been conducted on a coordinated interstate basis, and it is on this basis that the project will reach fruition." Mr. Pirnie asserted that when the river floodwaters of the basin are stored instead of wasted to the ocean, the water resources of the basin will be adequate to provide for all the foreseeable water needs of all the 20,000,000 people in the area until the year 2000.

Operating under a mutual compact, the Delaware River Basin Commission would have three members each from New York, New Jersey, Pennsylvania, and Delaware. As soon as 1951 state legislatures can act on the compact, the governors of the four states can affirm the actions of their respective legislatures, and congressional approval be obtained, the Commission would then have the power to plan, finance, construct, and operate the integrated water improvements. It would store spring floodwater for release and sale to participating states as needed for domestic and industrial use; develop and sell hydroelectric power or falling water; operate the reservoirs of the system for the control of floods, pollution, and salinity; improve navigation; provide recreation; and improve fishing and oyster resources. It was proposed that the projected works be made self-liquidating over a 50-year period. Construction funds would be obtained from the sale of long-term bonds.

Stage 1 of the proposed development (Fig. 1) consists of a 118-billion-gal storage and river-flow regulating reservoir on the West Branch of the Delaware River at Cannonsville; a diversion dam on the main river near Barryville to divert excess water through a 17-mile tunnel connecting with the 278-billion-gal Godeffroy Reservoir on the lower Neversink and on Brashear Kill; a 65-mile pressure tunnel from the upper Godeffroy Reservoir to connect with the major water supply systems of northern New Jersey and with New York's existing main supply tunnels in Brooklyn; and an equalizing, chlorination, and filtration facility above the latter tunnel, east of the Ramapo River in New Jersey. Stage 1 will insure minimum flow of 4,000 cfs in the Delaware River at Trenton.

It is estimated that Stage 1 will cost $516,932,000, and that approximately twelve years will be required to obtain the necessary legislation and to construct the system and place it in operation. Estimated annual operating costs of developing and storing the 465 mgd in Stage 1, after crediting proceeds from sales of power, are estimated at about $18,100,000 per year, or $106 per mgd, stated to be low-cost water even at present-day prices.

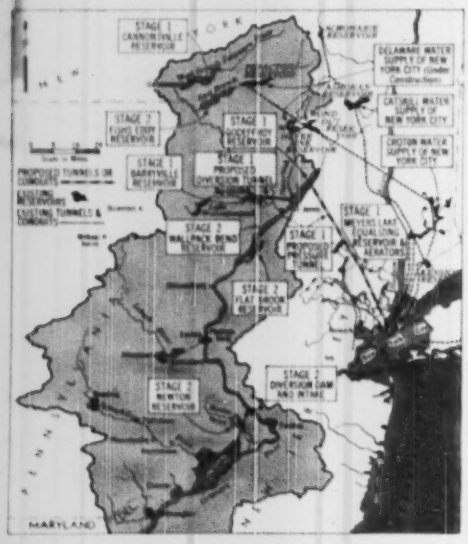


FIG. 1. FOUR-STATE PLAN for integrated conservation of water resources of Delaware River Basin is outlined here.

Incodel's Stage 1 construction of a dam at Cannonsville on the West Branch of the Delaware River overlaps New York City's plan for extending its Delaware Aqueduct to a reservoir on this tributary. Officials of the Board of Water Supply expressed friendly interest in the Incodel plan, but indicated that New York must have a new source of water by 1965.

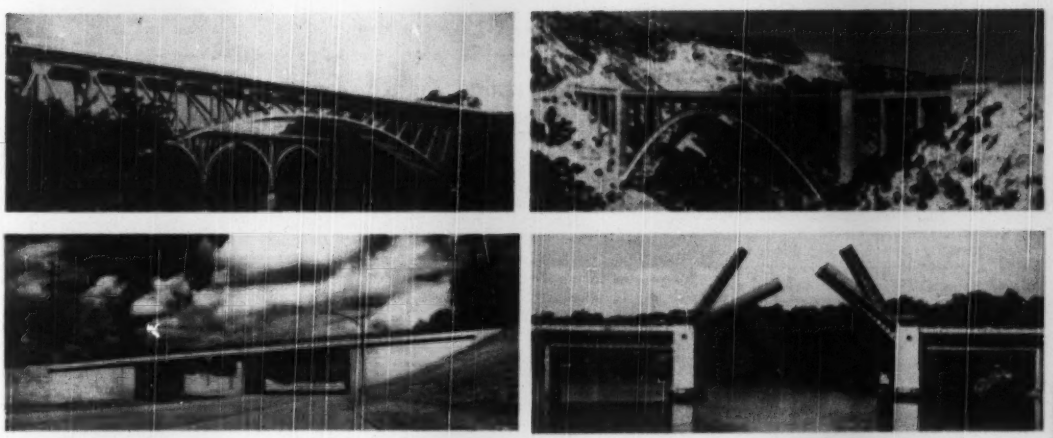
Stage 2 looks forward to the time when more than 465 mgd will be required. This envisages construction of additional storage: The 157-billion-gal Fishs Eddy Reservoir on the East Branch of the Delaware, and the 84-billion-gal Flat Brook Reservoir and the 121-billion-gal Wallpack Bend Reservoir on the main river. When Philadelphia and Southern New Jersey (Trenton and Camden) need more water, it can be delivered from Wallpack Bend Reservoir, either from a main river intake above Trenton, or by a 50-mile pressure tunnel direct from an equalizing reservoir on Neshaminy Creek. Philadelphia has had a reservoir at Wallpack Bend under consideration for an upland source of water. Both of these alternates would connect by tunnels and conduits to existing water treatment filter plants in Philadelphia. Stage 2 would cost from $250 to $300 million, depending on which alternate is adopted. The integrated development of both stages would produce a dependable yield in excess of 2,000 mgd and a minimum flow of 4,800 cfs in the river at Trenton.

"No greater contribution to the improvement of governmental administration in the field of river basin development could be accomplished than by adopting the Incodel procedure as a sound basis for a proper national water policy," said Francis A. Pitkin, reelected chairman of Incodel.

W. H. Allen, M. ASCE, executive secretary of Incodel, served on the Water Policy Panel of the EJC Task Committee on Domestic and Industrial Water Supply and Pollution.

Boston Will Modernize Its Waterfront Facilities

PLANS FOR THE development of pier facilities in South Boston will be made by the Port of Boston Authority with an interest-free advance of $118,900 obtained through the Housing and Home Finance Agency. The plans will cover wharf construction estimated at $4,100,000, the first stage in a five-part program for providing the city with modern facilities for handling waterborne cargo. Cost of the over-all pier-improvement project is estimated at $12,200,000.



PRIZE-WINNING STRUCTURES IN AISC COMPETITION for beautiful steel bridges built during 1949 are (left to right, upper view) bridge connecting Akron and Cuyahoga Falls, Ohio (Class I), and Pinto Creek Bridge, Arizona (Class II). In same order, lower photos show Tenth Street Bridge, Atlanta, Ga. (Class III), and Passaic River Bridge (Class IV).

AISC Gives Awards for Beautiful Steel Bridges

AWARD OF STAINLESS steel plaques for four bridges selected as the most beautiful steel bridges opened to traffic in the United States in 1949 is announced by the American Institute of Steel Construction. Except during the war years, the AISC has conducted an annual contest for esthetic steel bridges since 1928. A jury of architects and engineers chose the winning structures from a field of 46.

In Class I, for bridges with spans of 400 ft or more, the award goes to the North Main Street High Level Bridge at Akron, Ohio, connecting Akron and Cuyahoga Falls. Owned by the County Commissioners of Summit County, Ohio, the structure was designed by Wilbur Watson Associates and the steel fabricated by the Bethlehem Steel Co.

The Pinto Creek Bridge, near Superior, Ariz., was winner in Class II, for bridges with spans under 400 ft costing over $500,000. The owner is the Arizona Highway Department, the designer was the Bridge Division of the Department, and the fabricator the Allison Steel Manufacturing Co.

The award in Class III, for bridges with spans under 400 ft costing less than $500,000, goes to the Tenth Street Bridge on the Expressway at Atlanta, Ga. Designed by Robert & Co. Associates and fabricated by the Virginia Bridge Co., the structure is owned by the State Highway Department.

In Class IV, for movable bridges, the winning structure is the Passaic River Bridge between Clifton and Rutherford, N.J. Owned by the New Jersey State Highway Department, the structure was designed by the Department, for which ASCE Director Morris Goodkind is bridge engineer.

Honorable mention in Class I went to the Chesapeake City Highway Bridge over the Chesapeake and Delaware Canal in Maryland. The government owns the structure, which was designed by the New York City firm of Parsons, Brinckerhoff, Hall and Macdonald and fabricated by the American Bridge Co.

In Class III, first honorable mention was given to the Watauga River Bridge at Wagner Island, Tenn. The owner is Johnson County, the designer was the Tennessee Valley Authority, and the fabricator the Nashville Bridge Co. Recipient of the second honorable mention in this class is the East Henrietta-Rochester Bridge in Monroe County, New York. Owned by New York State, the structure was designed by the State Department of Public Works and fabricated by the American Bridge Co.

Honorable mention in Class IV went to the Bataan-Corregidor Memorial Bridge over the Chicago River in Chicago and the South Capitol Street Bridge over the Anacostia River in Washington, D.C. The first of these is owned by the City of Chicago, and was designed by the city Division of Bridges and Viaducts. The Government of the District of Columbia is owner of the South Capitol Street Bridge, which was designed by Modjeski & Masters. The American Bridge Co. was fabricator of both structures.

Houston, Tex., to Double Present Water Capacity

A PROGRAM TO increase the water supply of Houston, Tex., will soon get under way as the result of a popular vote, on August 26, approving a $24,000,000 bond issue for the project. Though Houston is one of the nation's fastest-growing industrial cities, it depends entirely upon wells for its water supply. A principal argument for passage of the water-bond issue was a forecast by engineers and city officials that the city would face a severe shortage by 1953.

Utilizing the water of the San Jacinto River, the projected plan will involve construction of a $7,500,000 dam and a $1,585,000 reservoir about 15 miles northeast of the city. The project will augment the city's water supply by 150 mgd, of which 50 mgd will be treated for domestic use, 75 mgd of raw water will be available for industries, and the remainder will be held in reserve.

In addition to the dam and reservoir, the project will involve construction of a $4,500,000 filter plant, with a capacity of 50 mgd and a potential capacity of 80 mgd; a $375,000 pumping plant and allied facilities on the San Jacinto River; and a system of canals and conduits for transporting the water. About $4,000,000 of the bond issue will be devoted to the development of present water sources, which are producing about 180 mgd.

It is expected that bids for the project will be asked before the end of 1950, with work due to begin early in 1951. The middle of 1952 is slated as the completion date.

Small Countries Become Major Customers for Steel Exports

THE FIVE LEADING importers of steel from the United States in 1949 were Canada, Venezuela, the United Kingdom, Mexico, and the Union of South Africa, in that order, according to an announcement from the American Iron and Steel Institute. Norway and Saudi Arabia, two countries formerly far down on the list of customers for steel from the United States, moved into sixth and seventh places. France, which was fourth largest importer of steel in 1948, decreased its tonnage of purchases by 60 percent last year.

Total exports for the year came to 4,682,110 tons, a slight increase over the previous year.

HHFA Loans Expedite Ohio Valley Pollution Control

INTEREST-FREE GOVERNMENT loans totaling almost $2,000,000 will advance installation of sewage-disposal facilities serving 105 communities in the Ohio Valley. The announcement comes from the Ohio River Valley Water Sanitation Commission, which represents eight states engaged in a joint campaign for the conservation of water resources by pollution control. The loans, which have been approved by the U.S. Housing and Home Finance Agency, are being employed in preparation of plans for 47 sewer and treatment projects in the eight states. Cost of the completed projects is estimated at $102,000,000.

With the largest single advance of $500,000, the Allegheny County (Pennsylvania) Sanitary Authority is designing a $59,000,000 intercepting sewer system and treatment plant (September issue, page 68). Youngstown, Ohio, receives $265,000, the second largest advance, for an estimated $9,000,000 construction program.

Hydraulic Experts Meet at Rocky Mountain Laboratory

BOTH PRACTICAL AND theoretical aspects of hydraulic research were discussed by authorities in the field at the fifth annual meeting of the Rocky Mountain Hydraulic Laboratory at Allenspark, Colo., on August 19. Carl F. Izzard, Assoc. M. ASCE, chief of the Hydraulics Branch of the Bureau of Public Roads, pointed out the need for hydraulic research in the solution of highway engineering problems. Other papers and progress reports dealt with the "Numerical Analysis of Continuous Unsteady Flow in Open Channels", "Study of the Performance of Weil Screens"; and "Tests of Bridge-Pier Scour Protection Methods."

Chesley J. Posey, M. ASCE, professor and acting head of the civil engineering department at the State University of Iowa, presided at a luncheon at Meeker Park Lodge. The all-day program also included inspection of the Allenspark laboratory.

Parking Garage Proposed for Penn Station, N.Y.C.

PLANS FOR CONSTRUCTION of an 800-car parking garage in Pennsylvania Station, New York, will be considered at an early meeting of the City Planning Commission, according to Jerry Finkelstein, commission chairman. Application for building the garage, which would utilize the space above the auto ramps at the south end of the building, has been made by Penstation Garage, Inc. Proposed plans call for a four-story unit 453 ft long and 46 ft deep on the 31st Street side, and a six-story and roof unit, 218 by 115 ft, immediately to the north. The estimated cost of the project is $2,000,000.

According to Mr. Finkelstein, such a project "should go a long way toward relieving congestion in one of the most congested areas of the city. . . . In normal turnover the garage will take at least 2,500 cars off the street in that area daily."

Construction Activity Continues Steady Rise

FURTHER EXPANSION OF residential building and highway construction work in August brought the construction total for the month 3 percent above that for July, according to a joint release of the Construction Division of the Department of Commerce and the U.S. Labor Department's Bureau of Labor Statistics. Setting a new, all-time monthly record, the total value of new construction for the month was in excess of $2.7 billion, with private construction valued at $2 billion and public construction at $715 million, both moderately above the July totals.

The value of private residential building put in place during August was estimated at $1¼ billion, 60 percent above the August 1949 total and more than 60 percent of total private outlays for new construction. Expenditures for public housing rose to $27 million after a dip in July resulting from delays on New York City Housing Authority projects caused by the truck-drivers' strike. Industrial building continued its recent gains, and the volume of work on new warehouse and office buildings rose substantially. Highway construction increased 11 percent during the month to $900 million, compared with $775 million in August last year. Expenditures for most other types of public works leveled off at seasonal peaks.

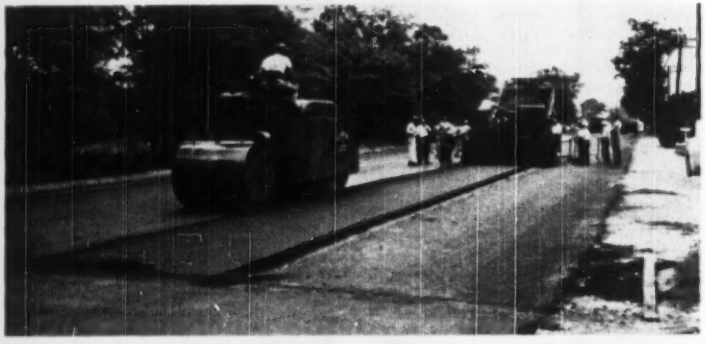
Figures for the first eight months of the year represented an increase of 20 percent over the corresponding period last year, according to the joint agencies. Private outlays were 25 percent greater, with most of the increase attributable to the record volume of homebuilding. Public expenditures for new construction during the first eight months this year were 9 percent above last year.

Stepped-up production of building materials in 1950 is expected to bring supplies generally into balance with requirements for use late this year, the Construction Division of the Department of Commerce reports in announcing that the output of building materials in June set an all-time record.

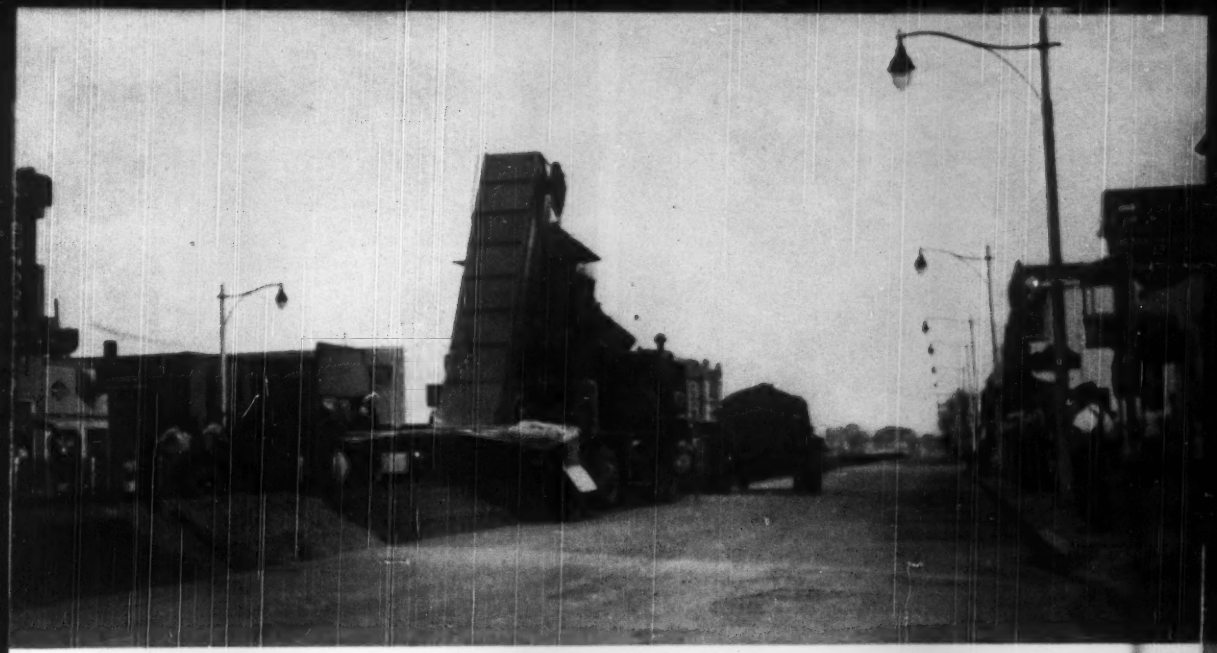
Shortages of cement, brick, gypsum board products, and other materials that developed during the year, the report states, were not due to a lack of productive capacity, but to several other factors—chief among them, the unanticipated volume of homebuilding. Production of a number of building materials could have been increased more rapidly during the early months of the year if the demand had been fully foreseen, the report continues. Distribution problems, including a shortage of railroad cars, have been responsible for some local shortages of building materials. Work stoppages, especially in cement plants, have also cut production at a crucial time.

Stating that a tight supply situation for several building materials may be expected to continue through October, the agency predicts that the subsequent seasonal downturn in construction activity should permit rebuilding of stocks by early winter if builders' purchases conform to the normal schedule in advance of actual use.

Massachusetts Lays Rubber Highway to Reduce Maintenance Costs



FIRST STATE IN NATION TO MAKE PRACTICAL USE OF RUBBER IN ROADS, Massachusetts installs longest rubber highway in world—5½-mile stretch of heavily traveled Route 1 running from Rhode Island line north to town of North Attleboro. Pavement, consisting of combination of stone, asphalt, and new meltable rubber compound developed by Naugatuck Chemical Division of United States Rubber Co., is laid over old concrete surface, which was badly cracked and patched. New pavement is expected to eliminate maintenance costs which were running as high as $1,000 per mile per year, reduce traffic noise, and increase riding comfort. Base is 1½-in. layer of heavy stone, rubber, and asphalt, while top consists of similar layer of fine stone, rubber, and asphalt. Test sections of rubber roads, installed by several states, show greater resistance to frost damage and wear than straight asphalt test strips laid adjacent to them. Photo courtesy of U.S. Rubber Co.



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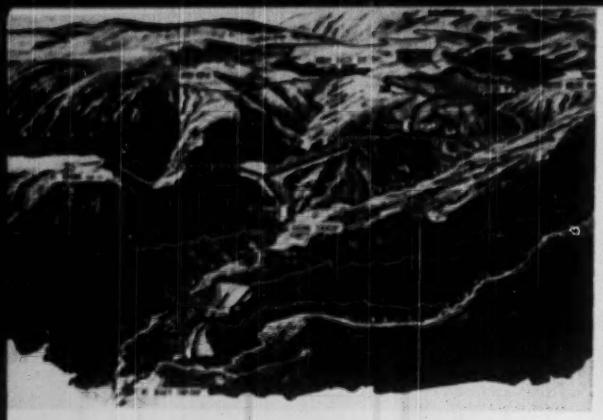
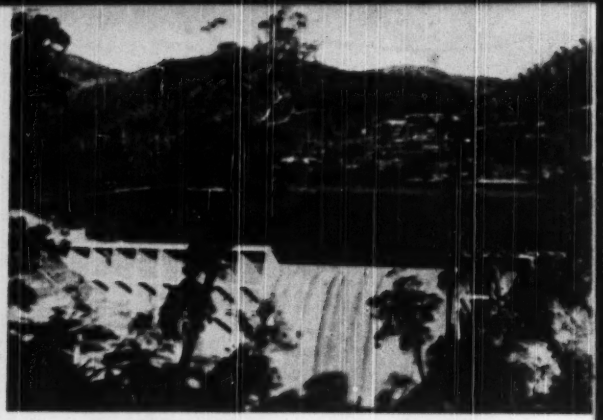




AUSTRALIAN ENGINEERS ARE TAPPING POWER RESOURCES of the southeastern mountain region of the continent to speed industrial development of the country. Substantial progress has already been made by Electricity Commission of State of Victoria on $70,000,000 Kiewa project (shown in artist's rendering at left) to harness streams and snow melt of storm-ridden Bogong-High Plains. Scheduled for completion in 1956, project involves construction of five dams, seven reservoirs, and six power stations, and driving of many miles of tunnels through mountains. Artist's sketch shows how water from major dams will be carried in tunnels to power stations at successive levels. Shaded portions indicate location of tunnels and power stations in solid rock. No. 2 power station, situated 650 ft underground, will be reached by elevator. Pretty Valley Dam (upper right in artist's sketch) will be among world's largest multiple-arch concrete structures and will impound 44,000,000,000 gal of water. Pictured at right is Bogong Village, first of settlements built for workers on Kiewa project standing above Lake Guy, which was formed by first completed dam in system. Just off drawing boards is vast Snowy River project, which will cost over $350,000,000 and have installed generating capacity of 2,620,000 kw. Australian official photo by Jack Gallagher.

Shortages of Materials and Labor Shown by AGC Survey

INCREASED SHORTAGES OF materials, machinery and skilled workmen have developed during the past two months, the Associated General Contractors of America reported at the mid-year meeting of its governing and advisory boards held at Chattanooga, Tenn., September 11-13. Basing its report on a recent nation-wide survey of conditions in the construction industry conducted through its 112 local affiliated organizations, the AGC attributes shortages principally to the unprecedented volume of construction activity. Other reasons cited are shortages of railroad cars for transportation, strikes in producing industries, and scare buying.

General price increases are also reported, with the sharpest rises in the price of lumber. Shortages of skilled workmen were noted by 68 percent of the group canvassed, while 76 percent reported pressure for increases in wage rates.

A continued large volume of construction for the remainder of the year is expected by a majority of the group.

Gains for Engineering Registration Reported

RECENT GAINS FOR engineering registration are noted in the September issue of *The Registration Bulletin*, quarterly publication of the National Council of State Boards of Engineering Examiners.

A new registration law has been adopted by Louisiana, following passage of the act by the state legislature and approval by the governor on June 30. The new law, which is based on the Model Law, follows very closely some of its provisions, especially the registration requirements. The bill will cover the registration of professional engineers in the following branches: agricultural, chemical, civil, electrical, mechanical, metallurgical, mining, and petroleum. It will also cover registration of land surveyors. Louisiana has had a registration law for civil engineers since 1908.

A bill regulating engineering practice in the District of Columbia and creating a Board of Registration for Professional Engineers in the District has been passed by Congress and signed by the President. This completes registration for engineers in the United States.

Further action strengthening the position of registration comes from Pennsylvania, where the Supreme Court recently upheld the constitutionality of the Pennsylvania Registration Law. According to *The Registration Bulletin*, "The opinion affirms the decision of the Superior Court that Howarth & Co. illegally rendered engineering services to the Gilman Manufacturing Co., because the principals of the Howarth Co. were not registered engineers, and hence could not succeed in an action to recover a fee."

New York Firm to Build Big FHA Housing Project

WORK ON A Federal Housing Authority housing project in Philadelphia will start at once, with award of a $2,750,000 contract to the Turner Construction Co., of New York. An L-shaped building, to be located at the intersection of Broad and Stiles streets, the new structure will include 300 apartments, a restaurant, seven stores, and a two-story garage. Completion is scheduled for January 1, 1952.

California Tunnel Bill Is Signed by President

A BILL AUTHORIZING preliminary studies for a tunnel through the Laguna Mountains in San Diego County, California, was recently signed by President Truman. A multi-purpose project, the proposed tunnel will serve both railroad and highway traffic.

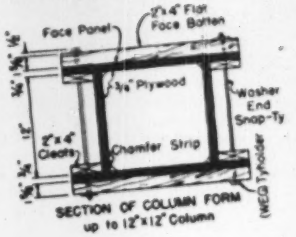
War Manpower Policy of United States Is Outlined

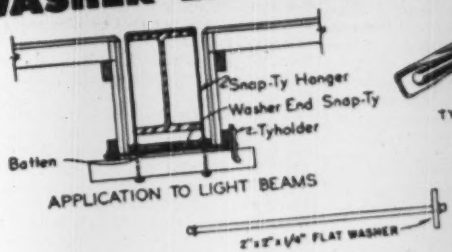
THE EFFECTIVE UTILIZATION of scientific and technical personnel is a topic of immediate interest to engineers because of the current international situation. This interest has inspired the preparation of several rosters of technical and scientific manpower. Engineers Joint Council has established an Engineering Manpower Commission, as noted elsewhere in this issue. The Department of Defense has published a policy of deferment, which includes both reserves and draftees. Following is a summary of the Department of Defense announcement, which is based on a "List of Critical Occupations" prepared by the Department of Labor, and a "Tentative List of Essential Activities" prepared by the Department of Commerce.

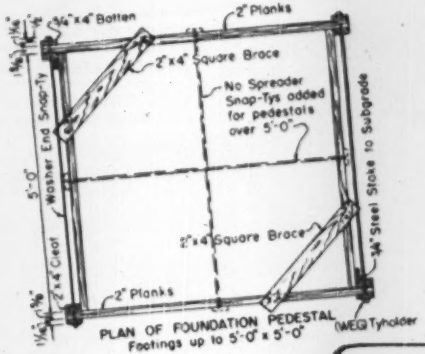
Reserve Policy

A reserve officer may have his call to duty deferred if he is engaged in a critical occupation necessary to an essential activity. In general, a critical occupation is one in which, under conditions of full mobilization, the demand for qualified persons would exceed the supply; a minimum training period of two years is necessary; and the occupation is essential to the functioning of the industry in which it occurs. An essential activity is one engaged in war production, or necessary for the maintenance of such production, or essential for the maintenance of the national health, safety, and interest. The list is broad enough to include all activities in which scientists or engineers are likely to be included.

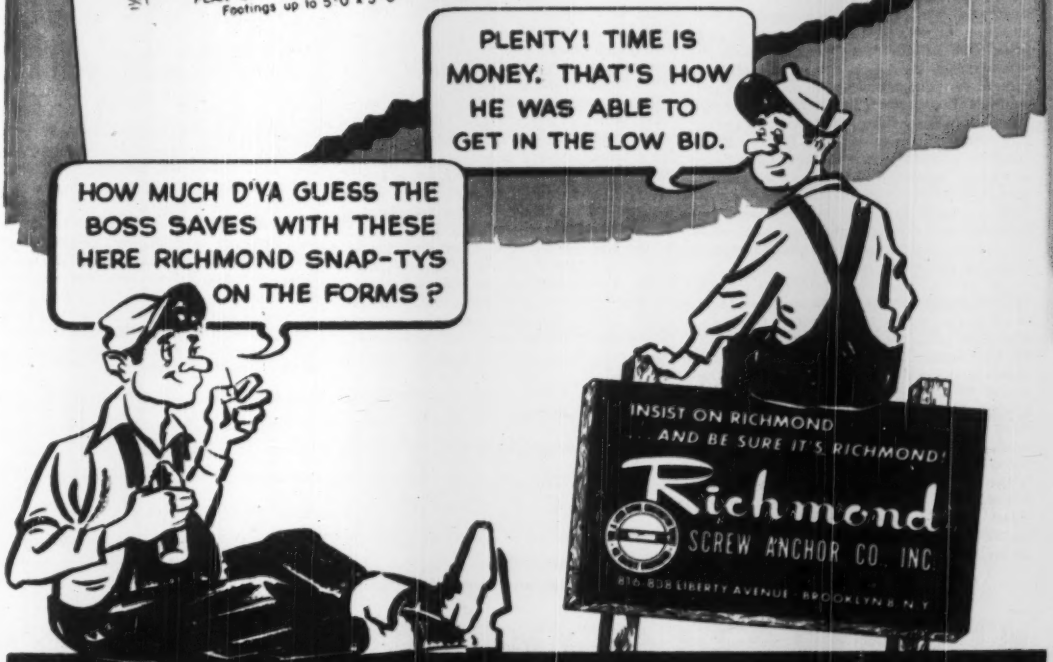
RICHMOND WASHER END SNAP-TY







Widely used as an external tie for light column or low heavy pedestal forms, this Richmond Snap-Ty has a ¼" x 2" x 2" flat washer against the head washer at one end. It speeds both form erection, stripping, and effects a substantial additional saving in lumber and nails. Richmond's Technical Department will prepare blueprints for you without charge showing how you can use this cost-cutting Snap-Ty on your jobs.


PLENTY! TIME IS MONEY. THAT'S HOW HE WAS ABLE TO GET IN THE LOW BID.
HOW MUCH D'YA GUESS THE BOSS SAVES WITH THESE HERE RICHMOND SNAP-TYS ON THE FORMS?
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RICHMOND KNOW-HOW—DEPENDABILITY—SERVICE—ESTIMATES & JOB PLANNING

Students in Reserves

Regarding students, the Department of Defense states: "Call to active duty of a member enrolled in an educational institution may be delayed until completion of the school term in which the member is registered. A member pursuing a professional graduate course or engaged in research in a technical or scientific field of primary interest to the Department of Defense should be granted delay in call to active duty. Such delay will be based upon the merits of the individual case." Delays are made for only six months, with the chances for delay diminishing with each succeeding request.

Application for delay can be made only after a reservist has received his call to active duty. For the Army, Marine Corps, and Air Force requests for delay to active duty must be made through the chain of command, although in the case of the Air Force a request is made to the headquarters of the area in which the reservist resides. In the case of Naval personnel, request for delay in being called to active duty is generally made to the Bureau of Naval Personnel through the Naval District Commandant.

Selective Service Schedule

Operations Bulletin No. 1, issued on August 8 by Selective Service, sets up conditions that may be considered by local boards in considering deferments, which in principle are similar to those listed above for reserves. The boards are directed to consider for occupational deferment college students fulfilling these three requirements: (1) The registrant has completed at least one academic year of a full-time course of instruction of college, university, or similar institution of higher learning; (2) the college or university at which the registrant last completed an academic year of a full-time course of instruction certifies that the registrant's scholastic standing placed him in the upper half of his class; and (3) the local board is satisfied by the registrant's actions in making normally required arrangements that he had fully intended prior to August 1, 1950, to enroll in a full-time course of instruction at a college, university, or similar institution of learning for the academic year ending in the spring of 1951.

The policy for graduate students follows (1) and (2) if in the last undergraduate year of a full-time course of instruction the registrant's standing placed him in the upper half of his class. When an assistantship in teaching or research is a requirement in the course being taken, the graduate student qualifies as a full-time student. However, since it is seldom a requirement that a graduate student hold an assistantship, although it is a normal arrangement and one frequently necessary for the student's financing of his training, the university should certify a man a full-time graduate student if it so considers him, whether or not he holds an assistantship.

Army Technical Detachment

Within the Army there is the Technical Detachment, to which technically trained enlisted and drafted personnel with special qualifications may be assigned upon completion of their basic training. Since the peacetime draft was begun in 1948, approximately 500 men have been assigned under this agency. Assignments to the Technical Detachment will not lead to assignment to Officers Candidate School. However, for those who do not attend O.C.S., such assignment will insure at least some use of technical competence. The minimum qualifications for special assignment to the Technical Detachment are: (1) Three full years of college and A.G.C.T. score of not less than 130; and a major in one of the physical, biological, or social sciences; or (2) completion of two full years in an accredited school of engineering and an A.G.C.T. score of not less than 110.

Assignment is made after completion of basic training. Students or others with the qualifications for special assignment, if not assigned under Special Regulation 615-205-1, December 8, 1948, should bring the matter to the attention of the appropriate authorities immediately following their induction or enlistment. If no action is taken, their name, rank, serial number, and the name of the organization to which they are assigned may be sent to the Office of Scientific Personnel, National Academy of Sciences, National Research Council, 2101 Constitution Avenue, Washington, D.C. This information will then be brought to the attention of the proper Army authorities.

As far as it is known, no special allocation of drafted or enlisted specialists has been established by either the Navy or the Air Force.

R. Robinson Rowe, M. ASCE

THE ENGINEERS CLUB was having its second annual meeting of the year and the wags were making the most of it, but the wagging tapered off when Professor Neare arose and glared and shrugged his beetle brows. All he said was, "Guest Professor Theo Dolite," and sat down.

Professor Dolite came right to the point—"The problem, stripped of fiction, is to survey a circle thru two given points subtending a diameter of a given circle. This, of course, is too difficult for Joe Kerr, or is it?"

"Yes and no," hedged Joe. "I've essayed quite a bit and I know how 9 out of 11 SI's would do it—balance, juggle, straddle or wiggle it in. I'd try a diameter JK and see if angles JAK and JBK were equal. If not, I'd try another, and then interpolate for the third try, and I'd have the curve run in before the other two SI's found the right page in Chauvenet. But if you want the slow, tedious, precise, academic method, ask Cal."

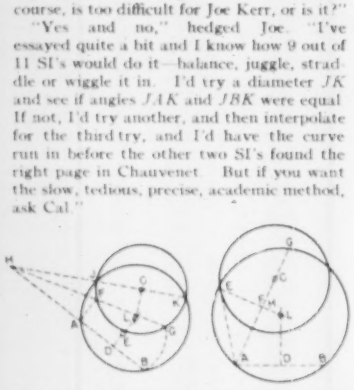

FIG. 1, (left) CAL USES a far sight, and in Fig. 2 (right) Theo uses polars and reciprocals.

"That was forbidden by the rule against computations," replied Cal Klater, "but there is a direct way that isn't slow. In Fig. 1, we are given A and B and the circle centered at C. Using as a center E on DE, the perpendicular bisector of AB, draw the arc AB intersecting the given circle at F and G. Extend chords AB and FG to their intersection at H and draw HC intersecting the given circle at J and K. Then JK is the required diameter, and a perpendicular at C will intersect DE at the center L of the required circle."

"Nice with edge and compass, but mean with chain and gun," scoffed Joe. "Why H is a mile away!"

"Purposely," said the Guest Professor, "to show another method. In Fig. 2, draw AE tangent to the given circle, drop EF perpendicular to AC and on AC prolonged, make CG equal to CF. Then G is on the required circle and the center can be found by intersecting the perpendicular bisectors DL and HL. Should we tell them why, Noah?"

"No, I'd hint at polars and reciprocals and let them tussle with it. To check enroute, you might tell them that $CG = \frac{r^2}{AC}$ and that $R = 13\sqrt{16,081}/168 = 981.336$ ft. Thanks, Theo, for a lesson in surveying. Our next lesson will pioneer a new field, saucerigation, with Professor Stoop Nagle setting up the problem."

"You could have told them, Noah, that saucerigation was merely avigation with saucers, which isn't at all complicated because saucers fly at constant speeds in straight lines and in rational formations. In Leif Hopper's flotilla, for instance, four disk-ships, as he called them, converged on the target area with the following positions at two consecutive minutes:

	At 1:00		At 1:01	
Ship	N	E	N	E
A	19	33	5	5
B	1	29	1	3
C	11	37	5	1
D	−16	18	0	0

Leif, in the flagdisk ship E, observed the other four continuously in the same azimuths. Now where was Leif at one o'clock?"

[Cal Klaters were: Sauer-Doe (Marvin A.) Larson, Stoop (John L.) Nagle and Anne Othernut (J. Charles Rathbun), Donald P. Thayer and Charles G. Edson. Guest Professor Dolite was Ray Samuelson.]

Above: Center Avenue looking north from the corner of City Park.

Right: View of Second Street looking west from downtown section.

In Curtis, Nebraska low annual cost leads to 7 to 1 popularity of CONCRETE STREETS

CITIZENS OF Curtis, Neb., have the unique distinction of owning perhaps more square yards of concrete pavement per capita than any other city in America—about 89 sq.yd. of concrete pavement for every man, woman and child in the city. There's a reason for this tremendous popularity of concrete.

Back in 1931, Curtis placed its first concrete paving—10 blocks, or 21,634 sq.yd. Those streets served so satisfactorily that in 1937, 18 more blocks, or 23,470 sq.yd., were paved with concrete.

Until 1948 not a cent was spent for maintaining those concrete streets. During 1948 and 1949 the total amount spent on maintenance resulted in a cost of only $.0016 per sq.yd. per yr. for the 18-yr. period.

When the citizens of Curtis were asked to express a preference, in 1949, for concrete or another type of pavement for the next project covering 30 blocks, they voted about 7 to 1 in favor of concrete, despite its higher initial cost. Years of experience had proved that it wasn't the first cost but the ***annual cost*** that counted. Today more than 75 per cent of the city's streets are paved with concrete.

The record of superior performance which made concrete the preferred pavement in Curtis is a familiar story in hundreds of cities from coast to coast. Concrete usually costs less to build than other pavements of equal load-carrying capacity. It costs far less to maintain and it renders longer years of uninterrupted service. These three factors result in ***low annual cost.*** That is the final accounting which pleases motorists and taxpayers alike.

For more information about how to design and build durable, ***low-annual-cost*** pavements write for your copy of a free booklet, *"Concrete Pavement Design."* Distributed only in the U. S. and Canada.

PORTLAND CEMENT ASSOCIATION

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A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

NEW IN Education

THE FOURTH VIRGINIA Highway Conference will be held at Virginia Military Institute in Lexington, October 12-13. Sponsored jointly by the Virginia Department of Highways and VMI's civil engineering department, the annual road meet will bring together some 600 state, city, and county officials for a discussion of Old Dominion road and street problems. Highlighting the program will be talks by Senators Harry F. Byrd and A. Willis Robertson of Virginia; Senator J. C. Stennis of Mississippi; Maj. Gen. Lewis A. Pick, Chief of U.S. Army Engineers; Gen. Philip B. Fleming, chairman of the President's Highway Safety Conference; and Virginia Governor John S. Battle.

A FIVE-DAY SHORT course on airphoto interpretation of soil patterns was held recently at Purdue University, under the direction of the school of civil engineering and engineering mechanics and the technical extension division. Lectures and discussions stressed the regional aspect of the relationship between soils, engineering problems, and airphoto patterns as an approach to understanding the techniques employed. Attendance included representatives from 30 states, who are engaged by highway departments, universities, consulting firms, and government agencies. K. B. Woods and R. E. Frost, Members ASCE, were directors of the course.

ESTABLISHMENT OF A new program, leading to the bachelor of science degree in meteorology, is announced by the University of Texas Department of Aeronautical Engineering. A brochure outlining the curriculum in detail will be available upon application to Kenneth H. Jehn, Assistant Professor of Meteorology, Engineering Building 133, University of Texas, Austin 12, Tex.

Deaths

Correction: **William Mueser** (M. '06) retired consulting engineer and Life Member of ASCE, died on August 4, at the age of 78, at the home of his son, **William Henry Mueser** (M. '37), in Mount Kisco, N.Y. This will correct a misstatement made on page 78 of the September issue.

Edward Taber Almy, Jr. (M. '22) assistant chief engineer, Sinclair Refining Co., New York, N.Y., died recently. He was 63. At the start of his engineering career, Mr. Almy served several mining companies in the United States, Canada, and Mexico, as assayor, surveyor, and engineer. For a number of years he worked for the American Coal & By-Products Coke Co., in Chicago. After service in the Army during World War I, Mr. Almy entered the employ of the Sinclair Refining Co. He attended Massachusetts Institute of Technology.

Ralph Oliver Anderson (Assoc. M. '28) supervisor of the analytical-control section of the photographic interpretation center at the Naval Receiving Station, Washington, D.C., died on August 23. He was 53. For 15 years Mr. Anderson worked for the Tennessee Valley Authority in Chattanooga and Knoxville. He was graduated from the Michigan College of Mining and Technology.

Frederick William Doolittle (M. '24) public utilities consultant to the North American Co., with headquarters in New York City, died September 13, at the age of 67. Mr. Doolittle had been a member of the executive committee of the organization for thirteen years and was a director of the company until 1947. Earlier he was a director of other utilities and coal mining companies and had engaged in private consulting practice. Since 1937 he had been chairman of the committee on public utilities and law of the Commerce and Industry Association of New York. He received degrees from Princeton University and the University of Colorado.

William Alfred Dunning (Assoc. M. '36) died suddenly at his ranch home in San Dimas, Calif., on July 29, at the age of 51. He had devoted the last four years to the raising of citrus crops and the development of marketing standards as a member of the Southern California Citrus Prorate Board. For 20 years previously, Mr. Dunning was a member of the engineering staff of the Los Angeles County Flood Control District as civil engineer, right-of-way agent, and finally as chief valuation engineer for eight years. During the latter period, he was responsible for right-of-way acquisition for the multi-million-dollar flood-control construction program of the Corps of Engineers in Los Angeles County as well as the District's land requirements.

Carson Geyer French (M. '17) for the past 35 years consulting engineer in Cleveland, Ohio, died there on August 20. He was 71. Before engaging in private practice, Mr. French worked for several railroad companies as designer, superintendent of construction, and bridge engineer on reinforced concrete structures. He was a graduate of Rose Polytechnic Institute, class of 1904.

Daniel Walters Gleason (Assoc. M. '25) died at his home at Bridgewater, Conn., on September 6, at the age of 60. Mr. Gleason began his engineering career as a draftsman for H. Olmstead, New York architect. From 1910 to 1920 he was in the employ of Westinghouse, Church, Kerr & Co. He then became connected with the Gorman Brown Engineering Corp., where he worked as assistant chief engineer on industrial buildings. More recently, Mr. Gleason was with Henry L. Doherty & Co., of New York City.

John Norcom Henrickson (Assoc. M. '18) South American manager of the Pan-American Airways, with headquarters at Los Angeles, Calif., died on August 3, at the age of 62. For a number of years Mr. Henrickson was with the San Pedro, Los Angeles & Salt Lake Railroad. In 1912 he became superintendent and chief engineer of the Huasteca Petroleum Co. Railroad at Tampico, Mexico. Mr. Henrickson had also been connected with the Pan-American Petroleum Co. He received his engineering training at the University of California.

Hay Issahrow (M. '48) civil and hydraulic engineer for the Palestine Electric Corp., Ltd., Haifa, Israel, died several months ago. He was 47. Since 1928, Mr. Issahrow had been employed by the Palestine Electric Corp. as resident engineer on construction of several hydroelectric powerhouses in Jordan, Haifa, and Reading, and as head of the construction of air-raid shelters at Jordan, Haifa, and Tel Aviv during the past war. He was loaned to Anglo-Iranian Oil Co., Abadan, in connection with war projects. He had a leave of absence in 1945 and 1946 for study in the United States under the auspices of the Bureau of Reclamation.

Eugene Thomas Kelly (Jun. M. '47) recently recalled to active duty in the Army Air Corps, was killed in an airplane crash near Parsons, Tenn., on September 1, at the age of 29. Previously Mr. Kelly had been a civil engineer with the Nashville, Tenn., Department of Public Works. He was a veteran of World War II and a graduate of Virginia Military Institute.

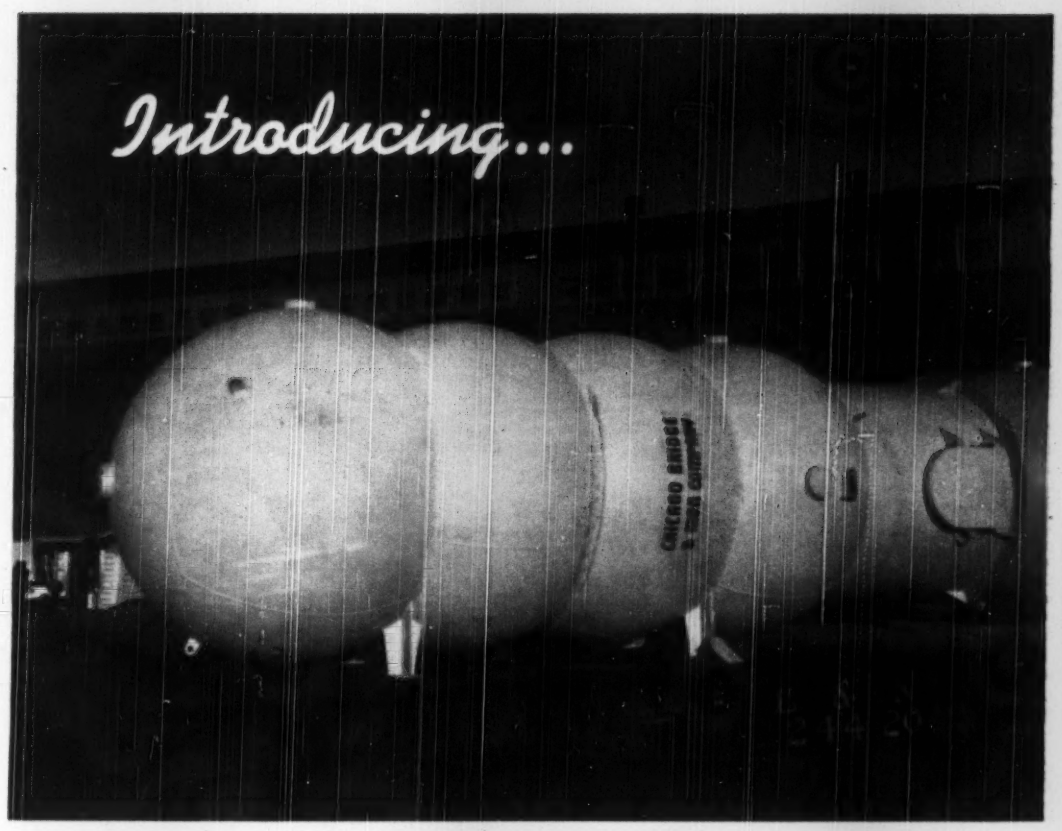
Lewis M. Martin (M. '17) who retired two years ago as district engineer for the Iowa State Highway Commission, died recently at his home in Council Bluffs, at the age of 73. As district engineer, Mr. Martin had directed road and bridge work in the southwestern counties of Iowa. For a number of years he was assistant engineer for the Chicago, Milwaukee & St. Paul Railway. He graduated from Cornell College at Mount Vernon, Iowa.

Chester Leroy Post (M. '13) consulting engineer for the General Services Administration, Washington, D.C., died there on August 21. His age was 70. Mr. Post, who recently had worked on the White House renovation, the new Public Health Clinical Center, and the General Accounting Offices, was to have retired late in August. At one time he engaged in private practice. He received his engineering training at Rose Polytechnic Institute.

Gratz Brown Strickler (M. '04) retired civil engineer and former colonel in the Army Reserve, Washington, D.C., died at his home near Leesburg, Va., on September 11, at the age of 80. Since 1947, Mr. Strickler had devoted his time to his beef cattle ranch. In his career as an engineer, he took part in building the Panama Canal, World's Fair buildings at St. Louis, and bridges in Cuba.

Samuel Alfred Taylor (M. '03) retired

(*Continued on page 68*)



...the latest development in storage tank design

Here is the Multisphere—newest member of the Horton tank family. It is a new development in storage tank design for this pressure container requires less metal and needs a smaller ground area.

The Multisphere may be used to store gases or volatile liquids under pressure. It's made up of spherical sections with flat, internal steel diaphragms between them to take the component of the stresses in the shell where the sections come together.

Spherical construction is economical in its use of material because the weight of metal needed to provide pressure storage for a given volume of gas is the same whether you use a single sphere, two or more spheres, a single Multisphere, or two or more Multispheres. The Multisphere makes it possible to utilize this principle for exceptionally large sizes or where special proportions are necessary to fit the tank in a limited space. (It is installed vertically on the base shown at the right of the illustration).

Furthermore, the Multisphere will withstand twice the pressure that a cylindrical vessel of the same wall thickness can withstand. This distinct superiority is due to the fact that when a Multisphere is subjected to internal pressure both the shell and the diaphragm are stressed in *equal, bi-axial tension.* Each welded seam in the shell joins two spherical segments and the edge of an internal diaphragm. All internal joints in diaphragms are three-way or four-way welds.

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• • • •

Above: Four-node Multisphere designed for an operating pressure of 400 lbs. per sq. in. and used to store nitrogen.

The Multisphere is one of a complete line of Horton steel plate structures that includes surge tanks, penstocks, smokestacks, flat-bottom steel tanks, elevated water tanks and steel plate work.

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Chicago 4	2199 McCormick Bldg.	LosAngeles17	1556General Petroleum Bldg.
Cleveland 15	2263 Guildhall Bldg.	New York 6	3395—165 Broadway Bldg.
Philadelphia 3	1652—1700Walnut St. Bldg.		
Salt Lake City 4	509 West 17th South St.		
San Francisco 4	1584—200 Bush St.		
Seattle 1	1309 Henry Bldg.		
Tulsa 3	1647 Hunt Bldg.		

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

(*Continued from page 66*)

consultant of Wilkinsburg, Pa., died there on August 20, at the age of 86. Before becoming a consulting engineer, Mr. Taylor was employed in the engineering department of Carnegie-Illinois Steel Corp., and the Pennsylvania Railroad. From 1910–1912 he was dean of the University of Pittsburgh School of Mines. He graduated from the University of Pittsburgh in 1887.

Sangarapillai Thanmavarather (Jun. M. '48) died in Ceylon sometime in March, according to word just received at Society Headquarters. He was 28. From 1941 to 1943, Mr. Thanmavarather was engaged in surveying and investigations on various construction projects in Ceylon. He attended lectures and practical classes at the Ceylon Technical College and received his engineering degree at London University in 1947. He then entered the employ of Howard Humphreys & Sons, civil engineers in London.

NEWS OF Engineers

R. Marrett Wheeler has been appointed assistant general manager and chief engineer of the Interstate Construction Co., of Charlotte, N.C. Previously he was with Wearn Lumber Co.

Julian Hinds, ASCE Director and district general manager and chief engineer of the Metropolitan Water District of Southern California, Los Angeles, has been elected vice-president of the International Commission on Large Dams, representing the United States.

John J. O'Farrell has been named management engineer in charge of methods engineering, inventory control, and IBM departments of the Hyster Co., Portland, Ore. He has been with Hyster three years.

Frank A. Banks, supervising engineer with the U. S. Bureau of Reclamation, at Grand Coulee Dam, Wash., has retired after 44 years of service. Mr. Banks' career has been spent in the development of the Columbia Basin, where he has supervised construction of five major dams in addition to Grand Coulee. The others include Jackson Lake and American Falls Dams on the Snake River, Arrowrock Dam on the Boise River, and Owyhee Dam on the Owyhee River in Oregon.

Charles H. Buford recently retired as president of the Chicago, Milwaukee, St. Paul & Pacific Railroad. Most of Mr. Buford's working years have been spent with the Chicago, Milwaukee, St. Paul & Pacific Railroad, where he rose through the ranks to the presidency. In 1939 he was elected vice-president of the Association of American Railroads in charge of operations and maintenance, with headquarters in Washington, D.C. He received many citations for his service in the field of transportation during the war, including the President's Certificate of Merit. Mr. Buford is an Honorary Member of the Society.

Charles H. Buford

Fred W. Facey, Jr., is in charge of the newly created Upper Savannah River office of the Corps of Engineers. The new office will supervise construction operations on Clark Hill Dam and Hartwell Dam near Augusta, Ga.

William D. Shannon, consulting engineer of Seattle, Wash., has been appointed Washington State Senator from the 43rd District by the King County Commissioners. Mr. Shannon has served the State of Washington in many civic capacities, including several terms in the state legislature. He is a former Director (1944–1946) and Vice-President (1947) of the Society.

J. L. Lytel, who has retired from active service with the International Boundary and Water Commission in charge of the lower Rio Grande flood control project, is making his home in Chula Vista, Calif. Starting his engineering career in 1900, Mr. Lytel was engaged by the U.S. Engineers in Cuba, the Bureau of Reclamation on the Strawberry Valley and Yakima projects in Utah, Washington, and Dwight P. Robinson Co. on the La Croze subway in Buenos Aires, Argentina, before his affiliation with the water commission.

Percy H. McGauhey has returned to Virginia Polytechnic Institute as head of the civil engineering department after teaching for a year at the University of Southern California. He was formerly professor of sanitary engineering at VPI and first vice-president of the ASCE Virginia Section. He will now serve as president of the Virginia Section, succeeding the late Sterry Mahaffey.

James W. Sloat is now executive officer of the Portland, Ore., District of the Corps of Engineers, succeeding **George A. Finley.** He has been with the Corps of Engineers for the past 14 years and saw active duty during the recent war in both theaters.

Frank W. Edwards, director of the department of civil engineering at Illinois Institute of Technology, has been appointed to assist Maj. Lenox R. Lohr in planning the ASCE Engineering Centennial Celebration for 1952.

C. T. Lindblom is a member of the newly organized engineering firm of Dodson, Kinney & Lindblom, of Columbus, Ohio. He was formerly assistant chief engineer of the Scioto-Sandusky Conservancy District at Columbus, Ohio.

D. B. Steinman, New York City consultant, has been retained by the government of Puerto Rico to design and supervise the construction of a $1,000,000 bridge over the Martin Pena Channel at San Juan. The structure will be part of the current program of highway construction in the metropolitan area of Puerto Rico, which is being undertaken with joint funds of the insular and federal governments.

Homer W. Jorgensen, formerly design engineer for the Los Angeles County (California) Sanitation Districts, has entered private practice in the field of sewage and industrial waste disposal in the San Joaquin Valley area. He is editor of *California Sewage Works Association Journal.* He has been serving as secretary of the Los Angeles Local Section of the Society.

Homer W. Jorgensen

Royden E. Reed has accepted the position of business supervisor of New Hampshire State Institutions, with headquarters at Concord.

Edmundo Curiel, who has been sanitary engineer with Oficina Tecnica Stubbins, at Caracas, Venezuela, has been appointed head of the National Institute of Sanitary Work of that city. Mr. Curiel is currently serving as secretary of the Venezuelan Section.

Emerson C. Itschner, until recently district engineer for the Corps of Engineers, at Seattle, Wash., has received an overseas assignment.

Gustave Magnel, professor of engineering at the University of Ghent, Belgium, recently received the Frank P. Brown Medal of the Franklin Institute for "outstanding development of engineering technique for prestressed concrete. The work," the citation continues, "resulted in radical improvements in the design and construction of bridges, buildings, and other structures, making it possible to depart from standard concrete arch construction." Professor Magnel's system for design and construction of prestressed concrete was first employed in this country in the construction of the Walnut Lane Bridge in Philadelphia.

Walter R. Hnot, for the past 13 years with the Standard Oil Development Co., sailed early in September for Antwerp, Belgium, where he will be engaged for two years on procurement work for a new refinery. Before taking this assignment, Mr. Hnot was owner's representative on the new Esso research center at Linden, N.J.

Walter R. Hnot

(*Continued on page 70*)

CLAY PIPE PROTECTS 'decision buyers'

WHERE products are "decision-bought" — by engineers, consultants, or men in public life — professional reputations are constantly at stake. The choice of Vitrified Clay Pipe protects those reputations, because Clay Pipe *never wears out.* It can be specified with safety on *every* sewerage or drainage job . . . for present or future wastes, for the soil conditions of tomorrow or fifty years from now. "Bad guesses" are impossible with Vitrified Clay Pipe. You can disregard sulphide controls and the effects of sewage temperature, velocities, and age of sewage, because Clay is immune to chemical action. It's the only pipe that's *sure* to protect *your* decisions . . . by lasting forever!

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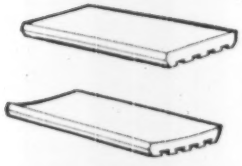

LINER PLATES

STANDARD-STRENGTH CLAY PIPE

CLAY PIPE FITTINGS

C-498-1

(*Continued from page 68*)

William G. Hoyt has been appointed to head the newly organized Division of Water and Power in the Department of the Interior, Washington, D.C. Mr. Hoyt is an authority on water, having been with the Department of the Interior for 43 years, since 1946 as vice-chairman and executive officer of the department's Water Resources Committee. He is a past president of the District of Columbia Section of the Society.

Ralph D. King has been assigned to the Armed Forces College, at Norfolk, Va. Previously Colonel King served as director of the Engineer Corps' Waterways Experiment Station, at Vicksburg, Miss.

David Howe Luzchesi, Jr., recently resigned as structural engineer of the Metal Products Division of Koppers Co., Inc., to become connected with Dietrich Bros., Inc., Baltimore, Md., steel fabricators.

H. G. Dewey, Jr., has left the staff of the Waterways Experiment Station, at Vicksburg, Miss., to report for active military duty with the 434th Engineer Construction Battalion. He will be executive officer. Major Dewey has been serving as secretary-treasurer of the Mid-South Section, and his duties will be taken over by **W. G. Shockley,** assistant chief of the Embankment Foundation Branch of the Experiment Station.

Theodore F. Collier, previously in charge of structural and architectural layout and design of steam electric and industrial development for Sanderson & Porter of New York City, has joined the staff of Westcott & Mapes, consulting engineers, New Haven, Conn. He will serve the company, which is engaged in power plant and industrial plant design, as senior structural engineer.

Additions to the faculty of the University of Florida include **Charles E. Cutts** as associate professor with teaching and research duties in the structural engineering field, and **Stuart R. Daniels** as instructor in civil engineering.

E. Q. Sullivan, who recently retired as district engineer for the State Division of Highways, San Bernardino, Calif., has opened a consulting office there. Mr. Sullivan served the Highway Division for 27 years, as district engineer of District VIII, San Bernardino County, and the western part of Riverside County, where he directed highway construction totaling $75,000,000.

Kurt Billig, for the past twelve years consulting engineer in London, has been appointed professor of civil engineering at the University of Hong Kong. Dr. Billig, who has been consultant to the British Ministry of Works, was in this country last year on a lecture tour reporting on progress made in Europe on prestressed concrete. He lectured at 25 universities and at numerous ASCE Local Section and Student Chapter meetings. Dr. Billig has left London for Hong Kong.

Kurt Billig

Thomas W. Stallworth, formerly associate professor of civil engineering at the Texas A. & M. College, is now chairman of the department of civil engineering at the University of Mississippi, succeeding **Dr. F. H. Kellogg.** Mr. Stallworth's experience includes four years with the Texas State Highway Department, one year as a contractor's superintendent, and three years at Texas A. & M. He also served four years in the Army Air Corps during World II.

Leo J. Foster, full-time consultant for the Bureau of Reclamation in Denver, Colo., has been cited by the Bureau for his 47 years of service—a record among the organization's 20,000 employees. Mr. Foster has worked on such projects as the Uncompahgre, Rye Patch and Boca dams. He directed construction of the All-American Canal and the Gila Project before going to the Denver post. He is not planning to retire until he reaches the mandatory age limit of 70.

Leo J. Foster

R. W. Gerdel, for the past seven years physicist for the U.S. Weather Bureau, at Sacramento, Calif., is now in St. Paul, Minn., where he is connected with the Army Engineers on snow, ice, and permafrost research.

E. Montford Fucik, associate of the Harza Engineering Co., of Chicago, was recently elected chairman of the General Education Committee of the Engineering Societies of Chicago, which is composed of delegates from the four Founder Societies and the Western Society of Engineers.

L. R. Douglass, since 1944 assistant regional director of the U.S. Bureau of Reclamation's Region 3, Boulder City, Nev., has been named acting director of power of the Boulder Canyon Project. Mr. Douglass has been with the Bureau for the past 17 years.

George L. Youmans has retired as vice-president of the Morrison-Knudsen Co. after 24 years of service in the construction department. He expects to make his home in Greenwich, Conn. Since 1943, Mr. Youmans has acted as head of the firm's New York office.

Gerald S. Rinehart, formerly assistant chief engineer of the Maryland State Roads Commission, has become connected with the Knappen-Tippetts-Abbett Engineering Co., as chief project engineer on the construction of the Cochabamba-Santa Cruz highway project in Bolivia. Knappen-Tippetts-Abbett are engineers for the Bolivian Development Corp.

Paul D. Berrigan, formerly district engineer for the Corps of Engineers at Kansas City, Mo., has been transferred to the National War College in Washington, D.C.

Fred J. Grumm, deputy state highway engineer for the California Division of Highways at Sacramento, has retired. In 1922 Mr. Grumm entered the employ of the California Highway Commission in Sacramento, becoming successively assistant division engineer in District VI, Fresno, engineer of surveys and plans, assistant state highway engineer, and in 1947 deputy state highway engineer.

Staff changes at the Illinois Institute of Technology include **Robert L. Janes,** who has been named senior structural engineer at the Armour Research Foundation at Illinois Tech, and **William R. Osgood,** who has been made director of mechanics instruction at the college.

CRITERIA INVOLVED IN ESTABLISHING equitable water-quality requirements are discussed at recent San Diego meeting of California State Water Pollution Control Board, which has been asked to formulate statewide control policy (June "Civil Engineering," page 62). Shown (left to right, seated) are Mrs. Lelia Bacskens, Orange, Calif.; A. M. Rawn, Los Angeles; Warren T. Hannum, Sacramento, ex-officio, Director of Natural Resources; Don D. Lucas, Bakersfield; and Don C. McMillan, Pasadena. Standing, in same order, are I. J. Krohn, Arcata; Keith Mets, Holtville; Gerald E. Arnold, San Diego; A. D. Edmonston, Sacramento, ex-officio, State Engineer; A. A. Brock, Sacramento, ex-officio, Director of Agriculture; Wilton L. Halverson, M.D., San Francisco, ex-officio, Director of Public Health; and Vinton W. Bacon, Sacramento, Executive Officer. The Progress Report issued by the Committee early this summer is still being studied and discussed. Mimeographed copies may be obtained from Executive Officer, State Water Pollution Control Board, State Office Building No. 1, Sacramento, Calif.

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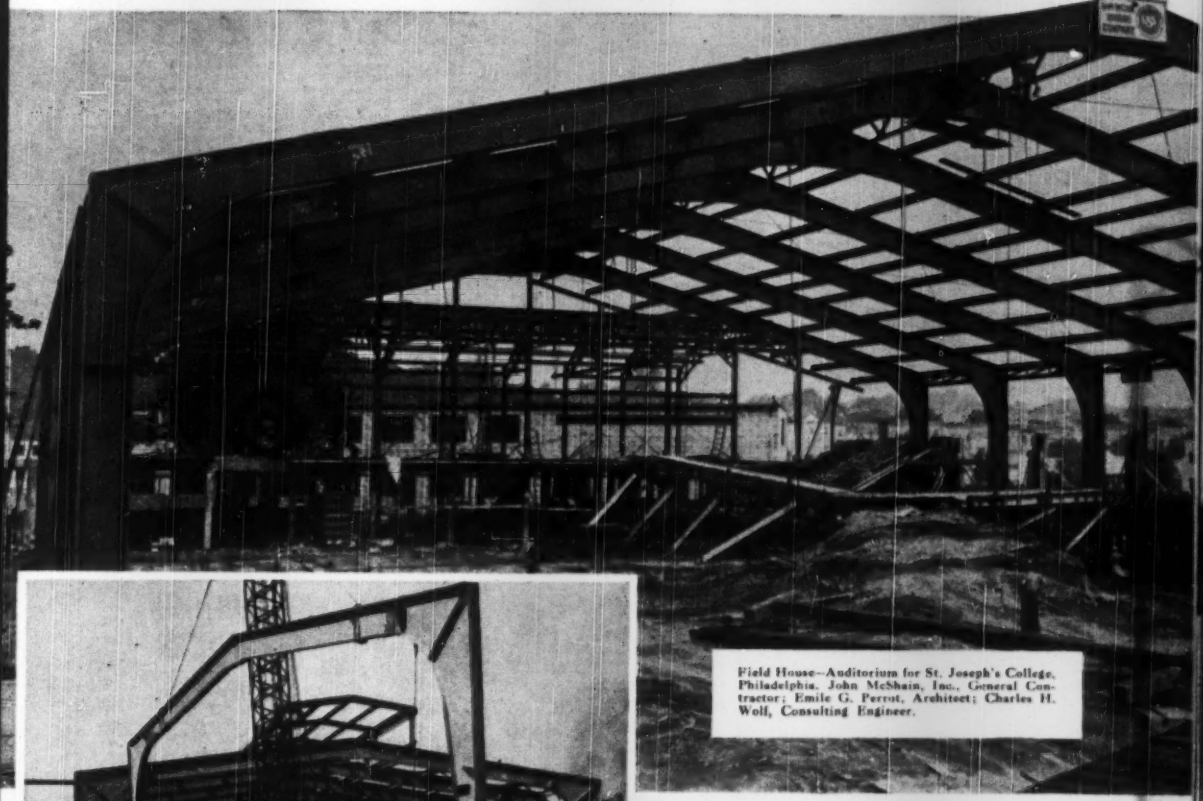
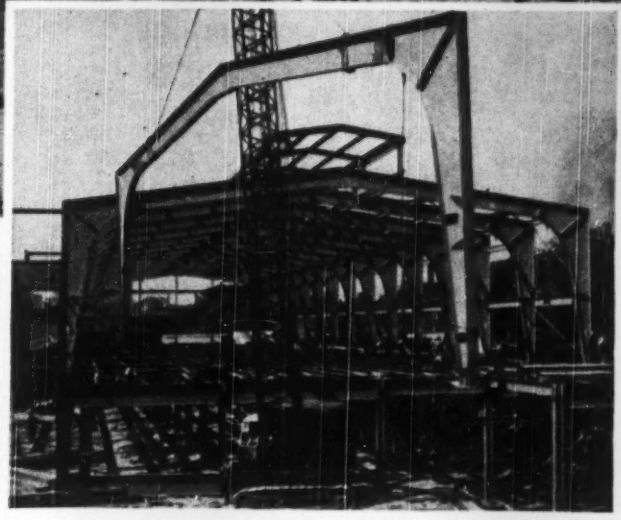


Field House—Auditorium for St. Joseph's College, Philadelphia. John McShain, Inc., General Contractor; Emile G. Perrot, Architect; Charles H. Woll, Consulting Engineer.



Bottling plant and case warehouse, Detroit, Michigan, for The Stroh Brewery Company. Harley, Ellington and Day, Inc., Architects and Engineers.

THESE two buildings, fabricated and erected by American Bridge Company, serve to illustrate some of the advantages of rigid-frame steel construction. The unobstructed floor area, the speed of erection, neat appearance, and economy which this type of construction provides may save money for you. For information on all types of construction, consult our nearest Contracting Office.

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ENGINEER. Jun. M. ASCE; ASME; 34; registered professional engineer. Production and plant engineering, design chemical process equipment, tablet presses, welded steel plate construction, ceramic equipment. Desires position as assistant chief engineer, chief draftsman, or salesman in Philadelphia area. C-625.

CIVIL ENGINEER. Jun. M. ASCE. B.S. in C.E. June 1949; single; 4 years' experience railroad construction, bridge and maintenance-of-way departments; 6 months' experience on road surveys. Ohio engineer-in-training license. Desires position in sales or position leading to sales. Willing to relocate and/or travel. C-626.

SANITARY ENGINEER. Jun. M. ASCE; 25; B.S. in sanitary engineering and M.S. in civil engineering; professional engineer, New York and New Jersey; 5 years' responsible charge of waste disposal and water supply research, development, design, and operations for manufacturer; ambitious and conscientious. Desires placement with promising future. C-627.

CIVIL-SANITARY ENGINEER. M. ASCE; over 20 years' experience; project promotion, investigations, reports, design and supervision of construction of water and sewage treatment plants, pumping stations, pipelines, power plants, dams, and highways. Capable executive, personable, effective contract negotiator and expert specification writer. Engineering and legal degrees. Registered several states and holds national certificate. C-628.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

CONSTRUCTION MANAGER-SUPERINTENDENT, M. ASCE; graduate civil engineer, thorough on-the-job experience constructing fireproof steel, masonry reinforced concrete and industrial buildings, mass housing, earth-fill dams and mass concrete structures; under 50; excellent health; prefers Ohio or Midwest location. C-629.

Positions Available

ENGINEERS. (a) Structural steel and reinforced concrete designers and draftsmen to design and lay out various types of structures. Y-4043.

CHIEF ENGINEER. 40–45, civil graduate, with at least 15 years' experience on design, construction, and administration of city water supply and sewage systems, including water treatment, distribution, sewage disposal, records, costs, public relations, and comprehensive supervisory work. Salary, $10,000 a year. Location, East. Y-4061.

ENGINEERS. (a) Structural Engineers who have had 3 to 5 years' experience in design and drafting on structural steel and reinforced concrete; industrial and institutional buildings. Salary, $4,680–$5,720 a year. Permanent. Location, Connecticut. Y-4068.

SUPERINTENDENT to be in general charge of an $8 million housing project. Must be familiar with FHA. Salary, $6,500–$7,000 a year. Location, Queens, N.Y. Y-4069.

DESIGN-DRAFTSMEN, civil, mechanical, and electrical graduates, with construction experience to design and lay out technical laboratory and industrial buildings, and various other structures. Salaries open. Location, Ohio. Y-4099(D).

STRUCTURAL DRAFTSMAN with 4 to 6 years' experience as designer and draftsman on plans and details for reinforced concrete and structural steel for industrial building. Salary, $4,500–$5,000 a year. Location, North Carolina. Y-4107(d).

STRUCTURAL DESIGN-DRAFTSMAN with at least 5 years' experience on cranes, ore bridges, conveyor supports, etc., to design and lay out heavy industrial equipment and structures. Salary open. Location, northern New Jersey. Y-4121.

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SEWER DESIGNER

Responsible position for engineer with experience in design of large scale sanitary and storm sewers. Salary $6640—7740. Full Civil Service status.

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CONSTRUCTION ENGINEER with highway construction and equipment, to give Sites for traffic lane markers, supervise operation of portable grinding machinery, and rolling of white plastic marking strip. Town or municipal engineering experience desirable. Considerable traveling throughout United States. Salary $6,000 a year plus bonus. Headquarters, New York. N.Y. Y-4137.

CONSTRUCTION SUPERINTENDENT with industrial building and heavy construction experience to manage jobs for general contractor. Location, Florida. Y-4153.

CIVIL ENGINEER, with considerable experience in water supply, distribution systems and water treatment, to do planning, design, estimating, preparation of specifications, and supervision of construction. Practical experience in construction essential. Experience in reservoirs and dams, both concrete and earth, familiarity with Latin American engineering practice and a knowledge of Spanish desirable. Salary open. Location, Venezuela. Y-4159.

DESIGN-SPECIFICATION ENGINEER, substantial experience in design of bituminous paving installations and preparation of specifications for a public works department of the government. Salary, $5,400 a year. Location, Illinois. R-6803.

CONSTRUCTION ENGINEER, some technical training, several years experience required with remodeling and new construction on stores, warehouses, and commercial buildings. Knowledge of general construction. Duties will be inspection and construction on stores and warehouses for large retail chain. Salary open. Location, Illinois. R-6827.

Airlift Airfield Gets Heavy Concrete Runway

(*Continued from page 25*)

in compression than the American ASTM method.

Flexure and compression tests of trial mix No. 2 with Rhine River gravel and with crushed stone (splitts) indicated the poor bond of the gravel and the good bond obtained with the crushed stone.

Pouring of concrete was completed November 4, 1949, and slope-line landing lights were installed December 22, 1949, thus giving Rhein-Main an additional runway capable of sustaining the largest military aircraft. Although the original design was intended for an 85,000-lb dual wheel loading, the new tandem-dual wheel design curves indicated a B-36 or its transport prototype could land on the new runway.

The total cost for the military's work in subgrade preparation was $196,048, or about 655,000 DM based on the prevailing conversion rate of 3.33 DM per U.S. dollar. Subdivided into the following items, as of the end of November, the costs for subgrade preparation were:

Equipment rental	$ 82,962
Labor	78,107
Supply items	5,011
Repair and maintenance of heavy equipment	29,968
Total	$196,048

Whether the project can be considered as money well expended can only be shown by its record for maintenance and repairs. As directed by Headquarters USAFE, accurate cost-accounting records were maintained to insure credit for the Deutsche Mark expenses borne by each party. A summary of the report on the contractor's share of the work is given in Table II.

Construction of the second runway at Rhein-Main was the result of the teamwork of the officers and men of the 862nd Engineer Aviation Battalion, the German contracting firm of R. Koegel, the field construction personnel of the Verkehrs-AG, and Sonderbauamt, Rhein-Main (Annex to the State Building Office, Land of Hesse).

Responsible officers for the project were Lt. Col. Charles H. Schilling, Commanding officer, 862nd Engineer Aviation Battalion; Capt. Howard K. Hasfurder, Officer-in-Charge, Battalion S-3 Section, which included design, specification writing, material testing and cost accounting; Capt. Robert B. Snodgrass, Commanding Officer, "B"-Company, who was responsible for concrete inspection and subgrade preparation. As the construction was a joint effort of the Occupation Forces and the Germans, acknowledgment is extended to the field engineers of the firm Koegel, Verkehrs-AG, and the Sonderbauamt, Rhein-Main.

Bridge Waterway Area Formula Developed for Indiana

(*Continued from page 26*)

small for large drainage areas, and Talbot's formula, which was developed for culverts, gives waterway areas that are much too large for large drainage areas.

The formula here presented, Eq. 1, should be used only for conditions of topography and rainfall similar to those in Indiana. It will not apply to arid regions, to areas having large average annual rainfall, or to mountainous country. An empirical formula should never be used blindly.

Waterway-area formulas give results that are approximate at best. The most valuable criterion for a waterway requirement is a structure or structures that have proved adequate in a major flood.

ESTIMATOR or COST ENGINEER

wanted for work in Brazil. Age 28 to 40. By North American Company which has been building hydro-electric projects in Brazil for past 50 years. First class engineering and construction organization with good opportunities for future. Salary to suit qualifications. In reply state experience and personal status in detail. Reply to Dept. WHK Canadian Brazilian Services, Ltd., Yonge & Gerrard Sts., Toronto, Ontario, Canada.

ASCE Hydraulics Division Meeting with 21st Annual Meeting of Mid-South Section, ASCE
Jackson, Miss., Nov. 1, 2, 3, 1950

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Dates of occupancy .....

Time of arrival .....

Mode of travel .....

Meetings and Conferences

American Concrete Institute. Headquarters for the regional conference of the American Concrete Institute will be the Mayflower Hotel, Washington, D.C., October 24–29.

American Public Health Association. The 78th annual meeting of the American Public Health Association and meetings of 32 related organizations in the field will take place in Kiel Auditorium, St. Louis, Mo., October 30–November 3.

American Welding Society. The annual meeting of the American Welding Society will be held in Chicago, October 23–27.

Engineers' Council for Professional Development. Headquarters for the 18th annual meeting of the Engineers' Council for Professional Development will be the Tudor Arms Hotel, Cleveland, Ohio, October 20–21.

Forest Products Research Society. Meeting of the Virginia-Carolinas Section of the Forest Products Research Society is scheduled for the Hotel Roanoke, Roanoke, Va., on November 3.

Materials Handling Conference. Under sponsorship of the Westinghouse Electric Corp., the third biennial Materials Handling Conference will be held in Buffalo, N.Y., October 24 and 25.

National Conference on Industrial Hydraulics. The sixth annual National Conference on Industrial Hydraulics is scheduled for the Sherman Hotel, Chicago, October 18–19. Sponsors are the Armour Research Foundation of the Illinois Institute of Technology and the Graduate School of the Institute, together with seven technical societies.

National Exposition of Power and Mechanical Engineering. New developments in the field of power will be presented at the 19th National Exposition of Power and Mechanical Engineering in Grand Central Palace, New York, November 27 to December 2, under the auspices of the American Society of Mechanical Engineers in conjunction with the society's annual meeting.

Structural Clay Products Institute. The Structural Clay Products Institute convention will take place at the Broadmoor Hotel, Colorado Springs, Colo., October 23–26.

Positions Announced

Civil Service Commission, Philadelphia. Announcement of an examination for Junior Land Planner (Grade 9) for the Philadelphia City Planning Commission, with a yearly salary of $3,642–$4,142, has been made by the Philadelphia Civil Service Commission. Application forms, which must be filed by October 16, 1950, may be obtained from Reuben Fritz, Civil Service Commission, Room 875, City Hall, Philadelphia, Pa. Inquiries should be addressed to Robert Chantigian, Executive Assistant, 18th Floor, Market Street National Bank Building, Philadelphia, Pa.

St. Lawrence Power Project Held Sound

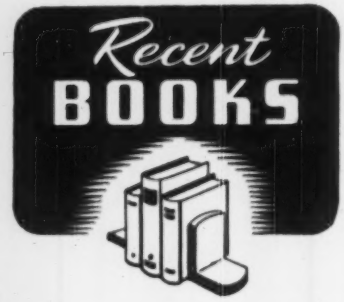
(Continued from page 45)

some municipal water work and sewage disposal plants. There will be at least some compulsion to operate efficiently, or the advantage in lower operating costs by way of exemption from taxation, cannot be passed on to the rate payer, and the semi-private or semi-public type of utility will suffer in repute.

Mr. Murrow has not made a very good case against the power project. One suspects that the reason he is against it is that the generation of approximately 1,000,000 hp of energy in upper New York State will materially cut into the present business of coal transportation. Admittedly, the hydroplant will do that, and admittedly the railroads will suffer to some extent, but the remedy is not in putting a road block in attempts to create more power in the United States—power that is independent of the regrettable, but real danger of shut-down due to strikes of coal miners or of railroad employees.

The well-informed citizen of the United States knows that the railroads rendered a superlative service during the last war and that we should not allow them to suffer in the unfair competition which they are encountering with directly or indirectly subsidized means of transportation. He knows that our defensive or offensive superiority lies not in our individual bravery, but in our power resources, applied to manufacturing, transportation, and communication. He probably knows that railroads don't want subsidies; that they do want freedom to operate in a businesslike manner, instead of being hampered by too much government regulation on the one hand and too much regulation by labor on the other. He also knows the solution of the railroad problem will not be found in successfully opposing a hydroelectric power plant at Massena on the St. Lawrence River.

F. N. MENEFEE M. ASCE
Professor of Engineering Mechanics, University of Michigan
Ann Arbor, Mich.



Applied Mechanics Dynamics

Prepared for use by junior engineering students, the text by G. W. Housner and D. E. Hudson serves as a logical transition from the elements of dynamics, as studied in general physics, to the more advanced courses. The main emphasis is on method and the development of fundamental principles with applications to problems drawn from various engineering fields. The first part consists of a concise treatment of the dynamics of a particle. The remainder presents applications of the same methods to systems of particles and rigid bodies. Published by D. Van Nostrand Co., New York, London, Toronto, 1950, the book contains 293 pages and illustrations and sells for $4.50.

Backgrounds of Power

The process of production by automatic machinery has had a steadily accelerating development. The author, R. Burlingame, traces this development from its origins to its present highly important position, covering techniques, materials, and basic philosophies. The story is told in human and social terms with emphasis on the effect of mass production on the individual and on civilization as a whole. (372 pages, tables, $5. Charles Scribner's Sons, New York and London, 1949.)

(The) Builders of the Bridge

First issued in 1945, this narrative of the life and work of John Roebling and his son by D. B. Steinman is now reissued with the addition of a two-page epilogue. The epilogue tells briefly of the author's commission to redesign the Brooklyn Bridge, and describes the tablet to be erected in memory of the wife of Col. Washington Roebling. Published by Harcourt, Brace and Co., New York, 1950, the book contains 457 pages, illustrations, and sells for $5.

Flow Measurement & Meters

A general survey of the art of metering the flow of fluids through both closed and open conduits is provided by A. Linford in this book. Various types of meters, the basic principles of their operation, their limitations, installation and maintenance are also discussed. Although practical in nature, some theoretical material is included on flow formulas and their applications as well as a classified list of references dealing with various hydraulic measuring devices. (336 pages, diagrams, 30s., E. & F. N. Spon Ltd., London, 1949.)

Fortschritte im Stahlbeton

The technology and mechanical properties of steel reinforcing bars for concrete are analyzed in considerable detail, with particular consideration given to the value of high-quality steels for reinforcement. Topics covered include tensile strength, ductility, slipping resistance, crack formation, and the importance of certain qualities to the strength of beams, columns, and structures as a whole. The types of bars and the research results are mainly European. A bibliography has been included by the author, R. Saliger. (138 pages, illustrations, $3.20. Franz Deuticke, Vienna, Austria, 1950.)

Handbook of Experimental Stress Analysis

This comprehensive reference book, written by thirty-one authorities in the field and edited by M. Hetényi, contains all the major experimental procedures that are being used in the investigation of mechanical strength. The subjects covered range from mechanical gages to X-ray analysis. Also included are such topics of interest as residual stresses, interpretation of service fractures, and analogies. In the appendix three theoretical subjects—theory of elasticity, dimensional analysis, and precision of measurements—are treated. Brief annotations given to the references are found at the end of each chapter. (1,077 pages, illustrations, $15. John Wiley & Sons, New York; Chapman & Hall, London, 1950.)

(Continued on page 77)

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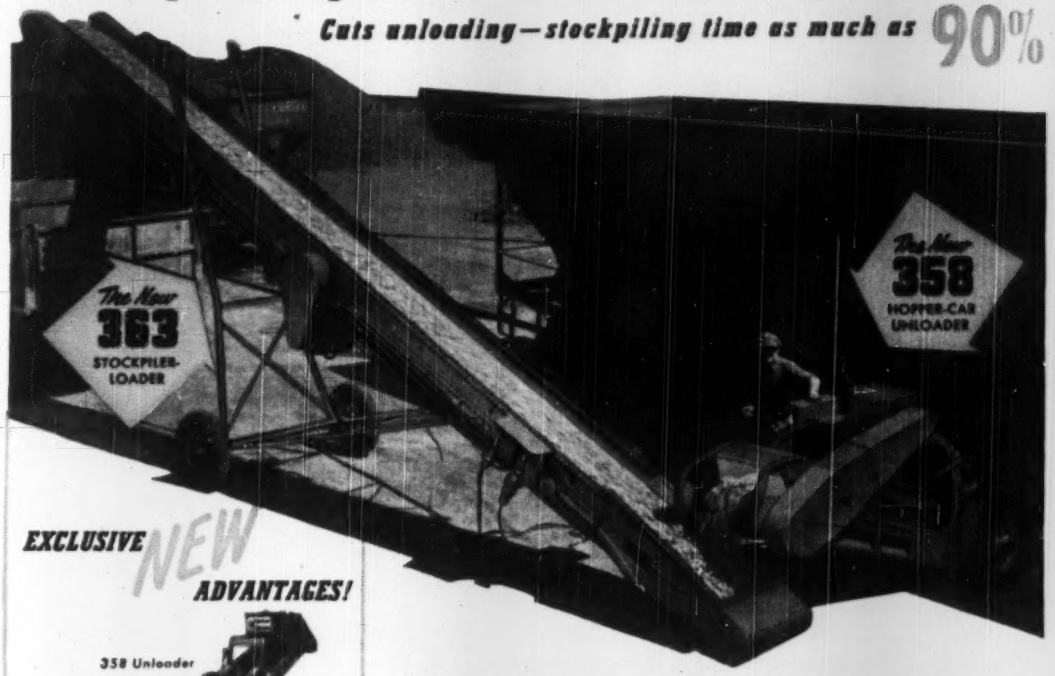

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About the Use of Calcium Chloride in Concrete

"The Effects of Calcium Chloride on Portland Cement" is a 40-page semi-technical book that tells you the facts about the use of Calcium Chloride in concrete. It describes in detail the carefully controlled tests that have been conducted by recognized authorities in the field and in the laboratory . . . and the results obtained.

Valuable Information For Contractors, Architects, Engineers, Plant Operators

Everybody who works with concrete—directly or indirectly—will be interested in this book. It gives factual answers to such questions as . . .

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- How much will Calcium Chloride reduce the curing period?
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These are just a few of the questions answered in "The Effects of Calcium Chloride on Portland Cement." In addition, there are graphs, tables, charts and much material that is now available for the first time in this book.

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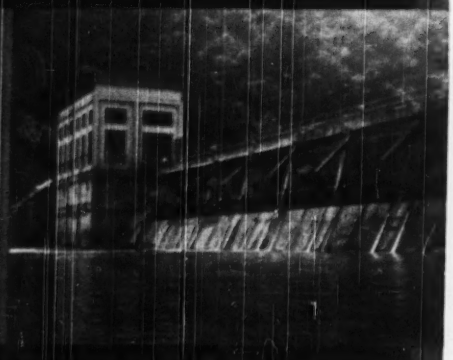

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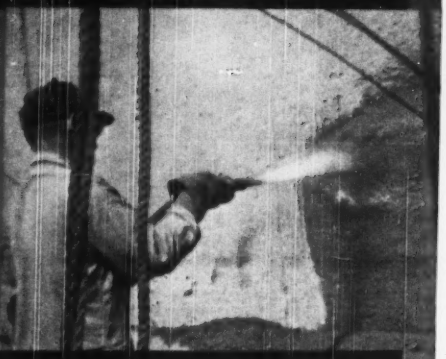

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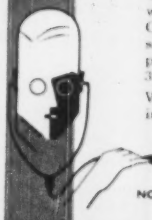

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(Continued from page 74)

(The) Inelastic Behavior of Engineering Materials and Structures

This book by A. M. Freudenthal provides a fundamental approach to the subject with main emphasis on the physical response of engineering materials to forces, time, and temperature. Following an examination of basic concepts, the structural and phenomenological framework of the theory of elasticity is developed. The remaining sections are devoted to selected problems of the mechanics of the inelastic continuum, to the design of engineering structures and to mechanical testing. (587 pages, illustrations, $7.50, John Wiley & Sons, New York; Chapman & Hall, Ltd., London, 1950.)

Municipal and Rural Sanitation

In the fourth edition of this text by V. M. Ehlers and E. W. Steel revisions have been made to conform to current practice. In addition to basic information on sewerage, sewage disposal, and water purification, such varied matters as the following are covered: the sanitation of swimming pools, of milk and other foods; refuse collection and disposal; control of mosquitoes, flies and rodents; plumbing inspection and other housing problems; insecticides and disinfectants. (548 pages, illustrations, $6.50, McGraw-Hill Book Co., New York, Toronto, London, 1950.)

Books in the Engineering Societies Library may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains research and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

National Transportation Policy

Based partially on a study of federal transportation activities made at the request of the Hoover Commission, this book analyzes the American transportation system with emphasis on basic issues of public policy rather than on details of administration. C. L. Dearing and W. Owen, the authors, point out the defects in federal action, set forth a program of needed policy revision, and recommend reorganization of federal government machinery designed to produce a more efficient transport system. Published by the Brookings Institution, Washington, D.C., 1949, the book contains 459 pages and sells for $4.

Roads, Their Alignment, Layout and Construction

Intended as a guide for young civil engineers, this book is based mainly on lectures on roads and streets given by the author, R. G. Batson, at the University of Liverpool. It opens with a brief historical account of the derivations of modern construction, the field work necessary in the preparation of road schemes and contract and working drawings. Special attention is given to the design of road junctions and the layout of roads to conform with modern practice. (224 pages, illustrations, $4, published by Longmans, Green and Co., London, New York, Toronto, 1950.)

Resistance Welding

The basic purpose of the author, W. A. Stanley, is to assist designing and manufacturing engineers in the development of their own ideas of how metal-made products may be more economically and efficiently produced. Equipment, materials used, design, tooling and production techniques are all discussed. Material is included on spot welding, projection welding, seam welding and flash butt welding. The nearly 800 illustrations include a wide range of specialized fabrication procedures. (329 pages, illustrations, $7.50, McGraw-Hill Book Co., New York, Toronto, London, 1950.)

Soil Mechanics in Road Construction

A general survey of soil mechanics covering soil surveys, soil testing and the interpretation and application of the results of tests is presented by C. F. Armstrong, the author. Design of flexible pavements, foundation design, treatment of embankments and cuttings, sub-soil drainage, and soil stabilization are dealt with in detail. Although essential theory is covered, the book is practical in its approach. (215 pages, illustrations, $5, Longmans, Green and Co., New York; Edward Arnold & Co., London, 1950.)

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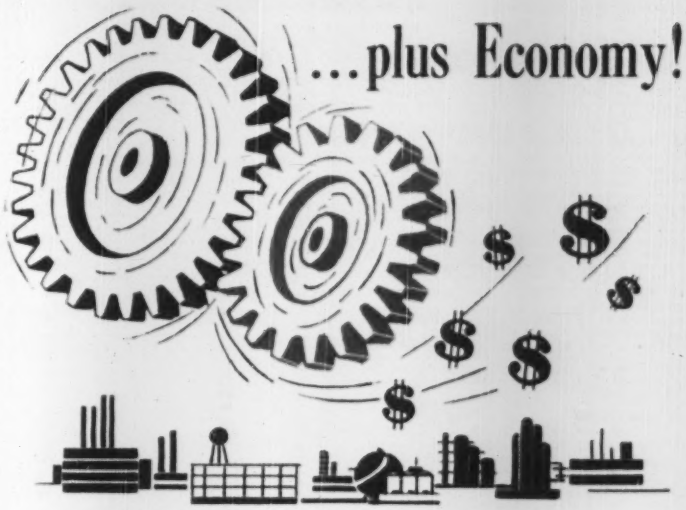

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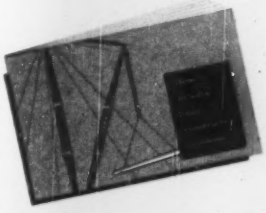

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CATALOG DIGESTS of ENGINEERING and INDUSTRIAL Interest

1 ABRASIVES

Calcium Chloride Assoc.—Brief IB-1 "Calcium Chloride for Ice Control" is available on request. It contains information from authoritative ARBA and HRB reports on types of abrasives, and recommended procedures for treating, storing and handling abrasives.

2 AERIAL MAPPING

Aero Service Corporation—offers catalogs or literature covering its varied aerial mapping services. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, airborne magnetometer surveys for ore and oil, and both plastic and plaster relief maps. Services discussed are used in highway design, plant engineering, industrial development, community planning, geological explorations and prospecting for oil or minerals.

3 AIR INLET VALVES

Simplex Valve & Meter Company—An essential booklet is Bulletin 125 for all engineers interested in pipe line construction and use. It describes fully and completely the theory and application of Air Inlet (vacuum breaking) valves and discusses why these should be installed on all thin-walled pipe lines where vacuum conditions might cause pipe collapse.

4 AIR TOOLS

Chicago Pneumatic Tool Co.—A 146-page, illustrated 1950 edition of an air tool catalog covering the complete line of industrial air tools is available. The catalog, 504-11, in fourteen sections, describes and gives detailed specifications of air powered: impact wrenches, screwdrivers and nut runners, drills, abrasive tools, riveters' hammers, hoists, winches, balancers, pumps, concrete vibrators, air motors, air line accessories, railroad equipment and allied CP products.

5 ALLOYS

American Meagenese Bronze Co.—A 30-page edition of the "Reference Book on Bronze Casting Alloys" gives general information regarding composition, characteristics and application of many of the common or typical alloys. The book will help the engineer or designer in the selection of the right alloys for any general application.

6 ARC WELDING

Lincoln Electric Co.—A series of studies of modern welded structures and modern welded design fundamentals is offered. The current series details design and construction of a modern welded deck girder highway bridge, 5 spans, 480 ft long. Buildings and building details such as rigid framing are covered in the recent studies. Free to engineers, architects and builders.

7 ASBESTOS-BONDED PIPE

Armco Drainage & Metal Products, Inc.—A 6-page folder entitled "Here's the Drainage Structure with a 'One Two' Punch" describes the structural strength and material durability of Armco asbestos-bonded pipe to withstand severe conditions. It describes how it is made, and photographs illustrate test installations and installations of industrial sewers and culverts in marshy and salt water conditions.

8 ASPHALT CONSTRUCTION

The Texas Company—Step-by-step descriptions of the various types of asphalt construction and maintenance for streets, highways and airports are offered by two booklets. One of these publications is entitled "Road Building with Texaco Asphalt by the Pressure Distributor Method." The other is devoted to "Texaco Asphalt Paving—Plant-mixed Types." Useful tables for the road builder and instructions for unloading asphalt products from railroad tank cars are included in this literature, which is offered to interested persons without charge.

9 BALL & ROLLER BEARINGS

Link-Belt Co.—The 112-page Data Book No. 2550 illustrates, tabulates and describes the full line of ball and roller bearings. It contains pages of valuable engineering information on how to select the proper bearing for a specific service, with diagrams and photographs of typical applications.

10 BLUEPRINT MARKING PENCIL

American Lead Pencil Co.—New brilliant colors in the Venus color pencil line for marking on blue or white prints. 54% stronger—sharpens to a sharp needle point and holds it. 27% greater markability—brilliant clear marking—waterproof, too!

11 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations" catalog B-2 explains the reason for subsoil investigations, what Gow borings are and how they are made, and results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

12 CENTRIFUGAL PUMPS

Economy Pumps, Inc.—now has available a revised catalog of non-clogging centrifugal pumps. The pumps featured in this catalog are designed to pass liquids containing solids from 2 to 10 in. in diameter; capacities range from 50 to 20,000 U. S. gal. per min.

13 CHEM-O-FEEDERS

"Proportioneers, Inc."—Bulletin describes application of chem-o-feeders for chlorine dioxide, hypochlorite, and chemical feeding to municipal and private water supplies, sewerage treatment, and swimming pools. Exclusive "See-Thru" reagent heads permitting visible inspection of all moving parts in contact with chemical solution, corrosion resistance, and ability to operate under high pressure are some of the advantages discussed.

14 COLD WEATHER CONCRETING

Lone Star Cement Corp.—The 16-page illustrated booklet gives detailed suggestions for minimizing winter concreting cost through the use of "Incor" 24-hour cement. Tables give mix proportions and approximate effect of temperature on compressive strength of concrete.

15 CONCRETE AIRPORT PAVEMENT

Portland Cement Assoc.—The 46-page booklet is a manual of new design procedures for runways, aprons and taxiways made necessary by heavier wheel loads and multiple wheel landing gears. It contains simplified design charts for determining slab thickness under different conditions of service, jointing practices, use of reinforcing steel, subgrade preparation and construction procedures for concrete resurfacing.

16 CONCRETE FORM-TIES

Richmond Screw Anchor Co., Inc.—Comprised of 8 sections devoted to the various styles, types and sizes of form-tying devices and other accessories for concrete construction, the new catalog is an extremely informative, fact-packed manual which shows by charts, pictures and word descriptions the proper selection and use of each of the items in the Richmond line. The catalog covers snap-tys, tyscrus, hanging systems, screw anchors and bolts, inserts and other devices.

17 CONCRETE PAVEMENT CONSTRUCTION

American Assoc. of State Highway Officials—A new and revised edition of "Specifications for Concrete Pavement Construction" has been released. It is a correlation of recommended standards of design and maintenance, representative of the best current practices for cement concrete pavement construction. 75¢ per copy.

N. B. There is a charge for this book. Make checks payable to the American Assoc. of State Highway Officials.

18 CONCRETE PIPE

Lock Joint Pipe Co.—A pamphlet describes all past installations of Lock Joint pressure pipe and is illustrated with cross-section cuts of joints and pipe design. Another illustrated pamphlet describes the manufacture and technical design of prestressed concrete cylinder pipe.

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Please have the literature indicated by the circled Catalog Digest numbers in the October 1950 issue sent to me without obligation.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17*	18	19*	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61*	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78*	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94*	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129*	130	131	132	133	134	135
136	137	138	139	140	141	142	143	144	145	146	147			

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NOT GOOD AFTER November 15, 1950, for readers in the U.S., but requests will be accepted to December 30, 1950, from readers outside of this country.

There are 147 Digest items on pages numbered 78 to 94. Read all items for the literature of interest to you. It is requested that students write direct to manufacturers.

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19 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication has just been released and is available to engineers. Contains information on design of irrigation pipe lines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 75¢

N B There is a charge for this book Make checks payable to the American Concrete Pipe Association

20 CONSTRUCTION DATA HANDBOOK

A. C. Horn Co., Inc.—A 96-page Horn Construction Data Handbook is offered. Each product of the company is listed as to description, use, covering capacity, color and packaging. Included in the catalog are construction details, and many tables and charts on weights and measures.

21 CONTROLLERS AND LAYOUTS

Simplex Valve & Meter Company—Bulletin 250 gives dimensional data on horizontal and vertical type controllers and clearance layouts for these units when using different type close-off arrangements. Type "S" rate controller for use in effluent lines from rapid sand type filters. This bulletin is of essential interest to the filter plant designing engineer.

22 CORE DRILLING MACHINE

Sprague & Henwood, Inc.—Bulletin No. 185 describes in detail Model 40-C, a core drilling machine. The outstanding construction features of this new unit are clearly presented and ample pictures enable the reader to understand better the combinations of power units and swivelheads that are available.

The Tenth of a Series in the interest of more efficient use of steel . . . a vital American resource

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TABLE OF ASTM A305 SPECIFICATIONS

		NOMINAL DIMENSIONS ROUND SECTIONS			REQUIREMENTS OF DEFORMATIONS		
Bar No.*	Unit Wt. Lbs. Ft.	Diameter Inches Decimal	Cross Sectional Area Sq. Inches	Perimeter	Max. Avg. Spacing In.	Min. Height Inches	Max. Gap Inches*
2†	0.167	0.250	0.05	0.785	.. ..	.. ..	.. ..
3	0.376	0.375	0.11	1.178	0.262	0.015	0.143
4	0.668	0.500	0.20	1.571	0.350	0.020	0.191
5	1.043	0.625	0.31	1.963	0.437	0.028	0.239
6	1.502	0.750	0.44	2.356	0.526	0.038	0.286
7	2.044	0.875	0.60	2.749	0.612	0.044	0.334
8	2.670	1.000	0.79	3.142	0.700	0.050	0.383
9‡	3.400	1.128	1.00	3.544	0.790	0.056	0.431
10‡	4.303	1.270	1.27	3.990	0.889	0.064	0.487
11‡	5.313	1.410	1.56	4.430	0.987	0.071	0.540

*Bar numbers are based on the number of ⅛ inches in the nominal diameter of the section.
†Bar number 2 in plain rounds only.
‡Bars numbered 9-10-11 correspond to former 1" sq., 1⅛" sq., and 1¼" sq. sizes, and are equivalent to those former standard bar sizes in weights and nominal cross-sectional areas.
*Chord of 12 ½% of Nom. Perimeter.

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23 CORE DRILLING MACHINES

Sprague & Henwood, Inc.—Bulletin No. 305 describes four of the more popular models of core drilling machines. This publication furnishes a brief description of the various machines and emphasizes the outstanding features of each. Capacities are shown for each drill when using the various sizes of standard diamond drill accessories available.

24 CORE DRILLING MACHINES

Sprague & Henwood, Inc.—Bulletins which describe the various core drilling machines in detail, accessory equipment Bulletin No. 31-F, diamond bit Bulletin No. 44-A, and several others are compiled in a general catalog that is now available for distribution.

25 CORR-PLATE STEEL PILING

Caine Corr-Plate Piling Co.—Complete description, specifications and photographs of typical installations are included in a new catalog. Corr-plate steel piling is the strongest piling per lb weight; cold rolled from open hearth steel; economical, light in weight; easy to handle, easy to drive and pull, and easy to transport (nestable). Can be used over and over again. Available in standard and inter-locking sections. Used widely in excavation and construction of foundations, dams, retaining walls, docks, levees, bulkheads, sewers, disposal plants, etc.

26 CRAWLER TRACTOR

Allis-Chalmers Mfg. Co.—An attractive 24-page catalog featuring the HD-5 crawler has been released. Photographs and cutaway views illustrate the "5's" track release mechanism, positive sealed truck wheels, and other features which simplify maintenance problems and assure longer life.

27 CRAWLER TRACTOR

Allis-Chalmers Mfg. Co.—A 24-page catalog featuring the HD-19 crawler tractor with torque converter drive, has been released. A cutaway view of the HD-19 highlights "A New Page in Tractor History" which lists many of the famous tractor's abundant features. Attention is given to several worthwhile track designs, and cutaway views and specifications on GM's two-cycle diesel engine provide a general description of the HD-19's power plant. Winding up this complete presentation, is a full list of tractor specifications.

28 CRAWLER TRACTOR

International Harvester Co.—A 24-page catalog describing the new International TD-18A crawler tractor is announced. Produced in two colors, it contains pictures, sectional views, and diagrams fully illustrating the features of the new tractor.

29 CRUSHING AND SCREENING PLANTS

Austin-Western Company—Bulletin No. 1999 describes the latest Austin-Western two-unit and three-unit portable crushing and screening plants which have been developed for either pit or quarry use. How these plants are capable of delivering high tonnages of aggregate in accurately controlled sizes, and how the three units (primary breaker, primary and secondary) may be used separately or in combination, as desired, providing flexibility of operation, is contained in the bulletin.

30 DIAMOND CORE DRILL

Pennsylvania Drilling Co.—offers literature illustrating the Penndrill Jeep, a diamond core drill for mounting on a 4-wheel drive jeep which can be readily set aside to free the jeep for other uses when drill is not required. The drill is driven by the jeep motor, has a capacity ranging from 500 ft of NX size hole to 1,000 ft of EX size hole, and is also available skid mounted, powered with gasoline and diesel engines, air and electric motors.

Please remember industrial literature is costly. It is requested that you ask only for those booklets of particular interest to you.

31 DIATOMITE FILTER

Permutit Co.—Bulletin 3415 describes the operation and advantages of the diatomite filter which requires less space, saves cost of coagulants and saves in amount of backwash water. The improved type of filter element is completely rigid, resistant to corrosion and lacks wires or screens which may be easily damaged or clogged.

32 DIESEL & CARBURETED ENGINES

International Harvester Co.—Two catalogs, form A-223-MM, with 24 pages on diesel engines and power units, and form A-490-MM, with 12 pages on carbureted engines and power units, are offered. These catalogs describe the various engines and power units, with specifications, power curves and pictures.

33 DIESEL CRAWLER TRACTOR

International Harvester Co.—A 24-page, two-color catalog, form A-383-NM, fully describes the 148.43 drawbar horsepower TD-24 diesel crawler tractor. The outstanding features of this crawler are shown in line drawings, diagrams, sectional views and photographs.

34 DOORS, STEEL ROLLING

Kinnear Manufacturing Company—The advantages, the economy, the construction features, and the general specifications of the various types of Kinnear Rol-Top all-steel sectional overhead type doors are fully discussed and illustrated in a new catalog and data book just published. Known as Bulletin 66, it gives information on insulation clearance requirements, methods of operations and controls, as well as the adaptability of the doors for many types of uses.

35 DOUBLE DISC GATE VALVES

Ludlow Valve Mfg. Co.—A 4-page folder, entitled "Built for the Future" gives the main features and construction details of the Ludlow double disc gate valves. It illustrates and describes valves with spur gearing for vertical installation and valves with bevel gearing for horizontal installation.

36 DRAFTING SUPPLIES

Berger Scientific Supplies, Inc.—will furnish upon request its well illustrated Catalog "A" describing a complete line of drawing instruments, side rules, T squares, curves, triangles, scales and other equipment for architects, engineers and draftsmen.

37 DRAWING PENCIL

Eagle Pencil Co.—Will furnish a free sample of their Eagle Turquoise drawing pencil in any degree of hardness requested.

38 DRY CHEMICAL FEEDER

Permutit Co.—Bulletin 3156 outlines the principles and design of the dry chemical feeder. The advantages of this type of feeder are: extreme accuracy, wide feeding range, stepless adjustment of dosage, reproducibility of feeding rate for any feeder setting, adaptability to either acid or alkaline chemicals.

39 DRAFTING MACHINE

Keuffel & Esser Co.—A booklet explains and illustrates the construction and time-saving operation of the Paragon drafting machine, which combines the function of T-square or straightedge, triangles, protractor, and scales into one unit easily controlled by the left hand alone, leaving the right hand free for drawing.

40 DURAPLASTIC CEMENT

Universal Atlas Cement Co.—A 20-page, 2-color commemorative booklet entitled, "A Decade of Atlas Duraplastic" traces the 1939-49 period of the origin, development and remarkable use-acceptance by the construction industry of Duraplastic air-entraining cement. With accent on pictorial-testimonial presentation, the booklet describes how Duraplastic was developed originally to solve the problem of concrete pavement scaling due to the use of de-icing salts; how it succeeded in this objective, from 1939 on.

41 EFFECTS OF CALCIUM CHLORIDE

Solvay Sales Div., Allied Chemical & Dye Corp.—has prepared a 40-page semi-technical booklet, of interest to architects, engineers and others concerned with specifications, design or production of Portland cement concrete. This booklet contains tables, graphs and charts covering setting time, early strength, curing, slump, density, surface wear, shrinkage, and ultimate strength. Also shown are effects of varying temperatures and cold weather, and the results with special cements including air entraining, high early strength and low heat cements.

42 ELECTRIC ERASER

Dremel Mfg. Co.—A circular covering the Dremel electric eraser is announced. The versatile tool erases faster and better, quickly sharpens pencil and compass leads, and burnishes erased areas for clean re-inking.

43 ELECTRICAL METALLIC TUBING

Republic Steel Corp.—A catalog answering such questions as what electrunite E.M.T. is, where it can be used, and why it should be specified has just been released. A chart on size ranges is also included.

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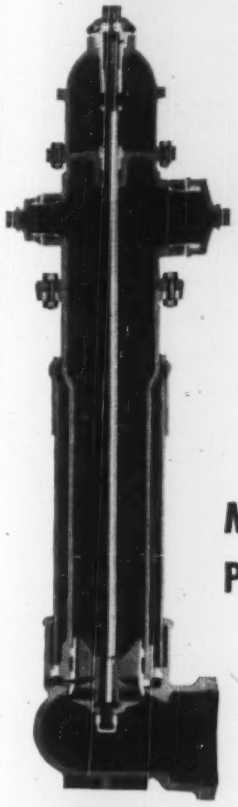

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Mathews Modernized Hydrants Set the Pace: All working parts contained in replaceable barrel • A broken Mathews can be replaced with spare in a jiffy, without excavating • Stuffing box cast integral with nozzle section • Head can be turned 360° • Replaceable head • Nozzle sections easily changed • Nozzle levels raised or lowered without excavating. Protection case of "Sand-Spun" cast iron for extra strength, toughness, elasticity • Operating thread only part to be lubricated • A modern barrel makes an old Mathews good as new

Please do not waste material.
Ask only for what you can use.

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YCGF No. 14 is one of a fleet of 18 cu. ft. YUBA bucket ladder dredges with digging depths ranging from 80' to 124' below water level. They range in age from 11 to 38 years.

YCGF No. 14 has averaged over 21½ hours operating time daily, digging and treating alluvial gravel

Dredge YCGF No. 14 was built by YUBA in 1912 for Yuba Consolidated Gold Fields. It has 18 cu. ft. buckets (originally 15 cu. ft.) and was designed to dig 62' below water level. To reach deeper gravels near Hammonton, California, Yuba later rebuilt the dredge to dig 80' below water. Except for the war years, No. 14 has operated continuously.

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The story of No. 14 is typical. Many YUBA dredges are operating efficiently after 25 years or more service. Often these dredges have been moved and redesigned to meet new operating conditions; thus, capital investment is spread over many years and great yardage.

No matter what your problem—deep ground, hard bedrock, boulders, levee or stream control—YUBA can help you. We will build a new dredge for you, help you obtain a good used dredge, or move, redesign and rebuild an old one. Write or wire us TODAY. No obligation.

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CATALOG DIGESTS

44 ELEVATED WATER TANKS

Chicago Bridge & Iron Co.—has recently issued an 8-page pamphlet, "The Watersphere," describing a modern type of elevated water tank constructed entirely of steel plates. It contains a description of the advantages of gravity water pressure as provided by elevated water tanks for fire protection and for general services. It also has illustrations and detailed information on the design and construction of the watersphere.

45 ENGINEERING INSTRUMENTS

W. & L. E. Gurley—An illustrated 64-page catalog, No. 50, describes the complete line of Gurley engineering instruments. Descriptions and specifications of several types of transits, levels, alidades, leveling and stadia rods, and plane tables with accessories are listed. Dip needle, cruising and geologists compasses are included, as well as current meters, water level recorders and wind instruments.

46 EXCAVATOR

Hyster Co.—The Hyster Hystaway, described in catalog 1076, is a versatile tractor-mounted ½-yd. excavator which provides a shovel, back hoe, dragline, clamshell and crane as interchangeable features. Designed for D6, D7 and D8 "Caterpillar" track-type tractors, the shovel mounts on either new or used machines, and utility use of a bulldozer on the rear of the tractor is possible even with the shovel in place.

47 FACILITIES & PRODUCTS

Newport News Shipbuilding & Dry Dock Co.—Illustrations on everyone of the 40-pages of this attractive book show some of the company's facilities and products in the process of manufacture. A wide range of facilities as to function, type, and capacity, together with a trained organization, are needed for the building of large compact vessels, producing rayon-yarn-spinning machinery, steel pipe lines, tanks, valves, gates, and a variety of equipment designed especially by the user. The company has long been pre-eminent in the manufacture of hydraulic turbines with installations throughout the world.

48 FIRE HYDRANT

Ludlow Valve Mfg. Co.—A 4-page folder, "For the Cities of Today and Tomorrow," lists the distinct advantages of the Ludlow slide gate hydrant, the Ludlow Diamond. It features construction details, explains the mechanism and has data required for ordering.

49 FISHING TACKLE

The Charles F. Orvis Co.—A large catalog of the finest fishing tackle with all equipment illustrated and described is offered. It features the famous custom-built Orvis impregnated split bamboo rods for trout, bass, salmon, grilse, steelhead, salt water, spinning and casting, and contains many suggestions on the right tackle for any type of fishing. Forty exciting pages for the fisherman.

50 FLASH MIXERS AND FLOCCULATORS

The Dorr Co.—The 8-page, two-color Bulletin No. 6671, entitled "Dorreo Flash Mixers and Dorreo Flocculators" contains photographs and complete descriptions of these units as well as the advantages attending their use. This bulletin also covers the various types of Dorr sedimentation units and illustrates by photographs and drawings the ease with which the flocculator operates in combination with these units.

51 FLOOR GRATING & SAFETY STEPS

Borden Metal Products Co.—Revised Catalog 14A-1 covers floor gratings and safety steps, floor armor and fasteners, with illustrations, diagrams and specifications. Also included are safe load tables, a description of Borden's planning and checking service, and a section covering instructions for specifying and ordering.

52 FOOTWALKS

Wm. F. Klemp Co.—offers its 1950 edition of their catalog entitled "Klemp Open Steel Grating and Stair Treads, the Perfect Structural Steel Flooring," containing information on riveted and welded grating, structural steel footwalks, bridge decking and drain grating, for use in refineries, power houses, sewerage units, mezzanine storage rooms, catwalks, heavy industries, bridges, etc. Fully illustrated, the book includes a safe-load table, and complete engineering data.

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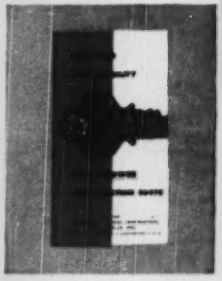

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CATALOG DIGESTS

53 FOUNDATIONS

Drilled-In Caisson Corporation—Literature describes foundation columns anchored in rock sockets; heavy column loads carried on single caissons; penetration through any type of soil to rock at any depth; examination of rock can be made; economy in time and labor; foundation bonded in rock; description, design, specifications, technical data.

54 FOUNDATIONS AND HEAVY CONSTRUCTION

Spencer, White & Prentis, Inc.—Literature on the construction of difficult and unusual foundations; description of concrete-filled steel tubes driven to rock, including technical data, performance and installation, description of Pretest Underpinning and the application of the Pretest Method to construction other than foundations; Pretest foundations; caissons; foundations under existing buildings; shoring and moving buildings.

55 FOUNDATIONS AND SOIL BORINGS

MacArthur Concrete Pile Corp.—A booklet giving concise data on pile foundations describes cast-in-place, composite, steel, sectional pipe, timber and H piles. Also given are notes on soil and rock exploration, and pile driving problems with special notes and engineering information covering 40 years' experience installing cast-in-place concrete piles.

56 GRATING-FLOORING AND TREADS

Irving Subway Grating Co., Inc.—Catalog F-225 contains illustrations, descriptions and engineering data on grating-flooring, treads and floor armoring (riveted, press-locked, welded types)—safe, durable, fireproof, ventilating, clean and economical—for industrial and power plant and refinery walkways, stairways, driveways, tracking aisles, ship cat-walks and engine room floors and treads; locomotive, freight and passenger car runways and treads; roadway armoring, expansion joints, catch basin covers; bridge decking.

57 GRID ROLLER

Hyster Co.—The Hyster grid roller, a tool for bituminous pavement salvage is described in a booklet. It consists of two 5½ ft diameter wheels or rollers attached to a frame for towing behind a motor grader or tractor. The design of the grid results in high pressure points which fracture and break up bituminous surfaces. Old material disintegrated by the roller may be reused and time saved by the method is substantial.

58 HAND LEVEL

Keuffel & Esser Co.—A booklet describes the precision-made hand level for speedy and convenient surveying. It also explains and illustrates how one man can use it for rough grading, locating contour lines, etc., and how he, with an assistant and a rod, can take cross section, set slope stakes, etc.

59 HEAVY CONSTRUCTION

General Electric Co.—The pages of this bulletin GEA 4731 tell the fascinating story of the successful application of new ideas to solve new problems—ideas that spell engineering progress. They are printed with the sincere hope that their review may encourage you to make greater use of the creative ability of General Electric engineers and specialists in your work.

60 HYDRANTS AND GATE VALVES

R. D. Wood Co.—A 22-page booklet, "Mathews Modernized Hydrant," gives detailed description of its various features, with numerous photographs and sectional views to clarify the text. Appropriate space is devoted to the Removable barrel, containing all the working parts, to the completely revolving head, and to the Sand-Spun protection case. A portion of this booklet is an illustrated treatment of gate valves that stay reliable under severe service conditions.

61 HYDRAULICS CALCULATOR

American Concrete Pipe Assoc.—A circular slide rule based on the Manning Formula is available to engineers. It will solve problems involving rates of flow, velocities, or slopes for pipes from 4 to 72 in. in diameter. Roughness coefficient "n" can vary from 0.008 to 0.020. Rate of flow can be in gallons per minute, million gallons per day or cubic ft per second. Price is $5.00.

N.B. There is a charge for this slide rule. Make checks payable to the American Concrete Pipe Assoc.

CATALOG DIGESTS

62 INDUSTRIAL PRODUCTS

Johns-Manville—The 40-page catalog contains descriptions, sizes, illustrations, and application data on the following J-M products: "Transite" asbestos-cement pipe, friction materials, packings and gaskets, refractory products, electrical products, asbestos products and industrial building materials.

63 INDUSTRIAL WHEEL TRACTORS

International Harvester Co.—Form A-378-MM is a 24-page, two-color catalog describing the complete line of International's industrial wheel tractors. It has cutaway views, line drawing, and performance charts describing the features of these machines. There is also a list of the various types of equipment that can be mounted on these tractors.

64 LEROY LETTERING EQUIPMENT

Keuffel & Esser Co.—Leroy lettering equipment enables any draftsman to do perfect lettering with speed and ease. Fully illustrated, this booklet gives complete information on Leroy lettering sets, templates, scribers, pens and accessories. Leroy templates are available in a wide range of styles and sizes, including regular Gothic, reverse, condensed and outline Gothic, Cheltenham and Greek alphabets; electrical, welding, map and geological symbols and isometric drawing.

65 MAIN STERILIZATION

%Proportioneers, Inc.%—Bulletin No. SM-9365, is a standard method bulletin on main sterilization and gives directions, calculations, typical main sterilization specifications, a water main sterilization chart and a description of the equipment required.

66 MECHANICAL PIPE JOINTS

R. D. Wood Co.—A 4-page leaflet describing mechanical joints that meet the requirements for permanent tightness of pipe joints under conditions of deflection, expansion, contraction and vibration. They are designed for high-pressure lines for oil, gas, water, steam, or chemicals.

67 METERING WATER FLOWS

Sparling Meter Co.—Meters that can be completely installed and maintained on main lines by water department personnel are gaining ever-wider acceptance. Sparling Bulletin 310 illustrates the adaptability of the propeller-type meter for long service, accuracy, conservation of pressure, and simplicity of operation. Accuracy curves, installation suggestions, and details of instruments are given with prices.

68 METRIC WALL CHART

Mayo Tunnel Equipment Co.—A wall chart has been designed for the rapid conversion of meters to feet and inches. It is stated to be very valuable to engineers who must frequently convert meters to feet, or vice versa.

69 MIXED FLOW PUMPS

Economy Pumps, Inc.—Mixed Flow Volute Type Pumps are the subject of a new catalog No. F-1049. Designed for high speed transfer of liquids that may contain light solids, Mixed Flow Pump applications include sewage disposal, irrigation, raw water pumping, reduction, and similar pumping operations. The catalog features construction details, photographs, drawings, and a selection table covering applications of these Pumps of various sizes.

70 MORTARPROOFING

Master Builders Co.—A 16-page illustrated booklet "Omicron Mortarproofing for Tight Brick Walls" describes the causes of leaky brickwork and tells how "Omicron" mortarproofing cement dispersing, water-reducing mortar admixture, helps correct these causes. Tests show how it improves the properties of all mortars, including those produced with prepared masonry cements.

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CATALOG DIGESTS

71 MOTOR GRADER

Allis-Chalmers Mfg. Co.—A 6-page leaflet covering the 34.7 hp Model D motor grader has just been released. This 2-color bulletin introduces a new machine with several popularly accepted big grader features such as tandem rear-wheel drive, tubular frame design, and rear-mounted engine-transmission construction for improved visibility. A liberal amount of action pictures illustrate the "D's" ability to cope with low cost maintenance and light construction work.

72 MOTOR OIL

Standard Oil Co. (Indiana)—The booklet entitled "Standolube HD Motor Oil" is a technical description and definition of heavy duty motor oils, illustrating through charts, photographs, and other data how Standolube HD has demonstrated its ability to cope successfully with the most difficult problems of lubrication in automotive, diesel and H.D. engines.

73 NON-CLOG PUMPS

Economy Pumps, Inc.—Applications for vertical non-clog open shaft pumps include sewage disposal, flood control, reduction, drainage of liquid containing sand or silt, food pulp distribution, and use in paper mills for stock pumping, water supply, and overflow. Complete selection table included in catalog No. F-249.

74 OPEN STEEL FLOORING

Kerlow Steel Flooring Co.—A 40-page catalog on open steel flooring for bridges contains latest engineering information on design and selection of grating and stringers. Catalog describes various designs and their applications for open flooring and filled slabs, with dimension charts, complete specifications, selection and installation data for each design.

75 PAVING HANDBOOK

Stancal Asphalt & Bitumuls Co.—A pocket-size, 80-page edition of the Bitumuls Paving Handbook is announced. It covers paving techniques with Bitumuls emulsified asphalt and also with other types of bituminous binders. The handbook gives information on paving methods, specifications on road and airport paving, complete tabular data on rates of application of asphaltic binders, and lists free booklets covering individual types of construction.

76 PAVING MATERIALS MANUAL

The Barrett Division—A paving materials manual, 48 pages, profusely illustrated, covers directions for new highway construction and maintenance, using Tarvia road tar and Tarvialithic bituminous concrete as well as other Barrett paving materials. Manual treats with such construction operations as road mixes, penetration, plant mixes, base stabilization, patching, surface treatment, bituminous gel, various road types, widening of existing roads, curing slippery pavements, etc. It also contains numerous tables giving data on tar grades, uses, aggregate sizes and uses.

77 PENCILS

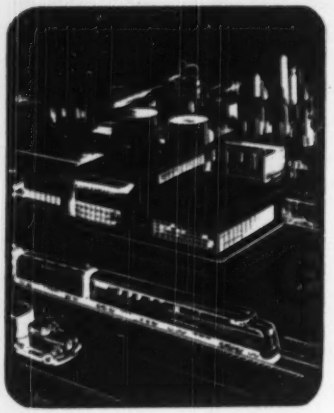
Eberhard Faber Pencil Co.—offers, without charge, one of their Microtomic Van Dyke drawing pencils in any specified degree. Microtomics are claimed to contain a special Hi-Density lead of an absolute uniform grading. The exclusive Hi-Density formula creates extra opaqueness without smudge. Its graphite content, 100× fine, produces a smooth writing, non-crumbling lead.

78 PENCIL SKETCHING

American Lead Pencil Co.—24 pages of helpful illustrated instructions on pencil sketching. Only 25¢ with two free Venus drawing pencils.

N. B. There is a charge for this book. Make checks payable to the American Lead Pencil Co.

When ordering literature for which there is a charge, please make checks payable to the company offering the material!



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CATALOG DIGESTS

79 PILES

Raymond Concrete Pile Company—Raymond Standard and Step Tapered Piles are described in literature which also includes information on the scope of Raymond's activities which cover every recognized type of pile foundation including poured concrete, precast concrete, composite wood and concrete, steel, pipe, and wood. Raymond's activities and experience also include the construction of caissons and construction involving shore protection, shipbuilding facilities, and harbor and river developments.

80 PILES AND CAISSONS

Western Foundation Corp.—Piles and caissons of several types adequate to meet the load-carrying needs and soil conditions of any site are described in the brochure. Featured are economical cast-in-place piles with a large base that carry the load to dependable bearing strata at whatever depth it may be reached. For specification writers there is a suggested pile foundation specification prepared on a performance basis that invites competitive bidding on all types of piles for greatest job economy.

81 PILE, TAPERED TUBULAR STEEL

The Union Metal Mfg. Co.—Descriptive information and engineering data on Monotube steel piles. The Monotube is a fluted, tubular steel pile, fully tapered or combining tapered and uniform sections. It is driven directly with standard pile-driving equipment without use of driving core or mandrel. Advantages listed: easy handling, speedy driving, economical field extendability, internal inspection after driving, high load-carrying capacity with consequent economy per ton of load carried.

82 PIPE LINE DREDGE

Ellicott Machine Corp.—offers Bulletin No. 806, which describes the new "Little Dragon," 8-in. hydraulic pipe line dredge. It describes the extreme portability and versatility of this dredge, which can be transported by truck or rail to remote dredging sites with a minimum of labor and equipment.

83 PITOT EQUIPMENT

Simplex Valve & Meter Co.—Bulletin No. 50 is a complete publication on the choice and use of Pitot equipment. Descriptive material covers instructions for use of Simplex Pitot tube and manometer, instructions for operation and use of Simplex portable Pitot recorder and, in addition, contains an entire section applied to theory, formulas, notations, tables and curves relating to Pitot tubes, manometers and recorders.

84 PLANTS AND PRODUCTS

American Bridge Co.—The attractive 16-page booklet describes pictorially the company's plants, products and services.

85 PLYWOOD

Douglas Fir Plywood Assoc.—A 20-page, 2-color 1950 Basic Catalog for Douglas Fir Plywood is announced. It gives types, grades and sizes of Douglas fir plywood, together with construction and finishing data, and includes recommended grade and thickness for typical uses.

86 POCKET TRANSIT

Wm. Ainsworth & Sons, Inc.—A booklet describing and outlining the use of the Brunton pocket transit and accessories is available. The booklet shows how horizontal and vertical angles can be determined to approximately one degree by using an instrument weighing only 8½ ozs. This will be of interest to engineers who have occasion to make rough surveys, check grades and levels, or lay out roads or lines.

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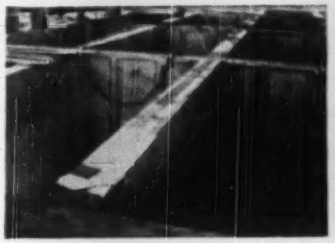

Photo (above, left) shows the "Gunite" lining we placed on the forty coal hoppers of Units number 1 and 2 at Pennsylvania Power & Light Company's new 150 m.w. turbogenerator installation at Sunbury, Pa. Photo (above, right) pictures the hoppers in use. Cement Gun Company is presently installing the "Gunite" lining in the hoppers of Unit number 3.

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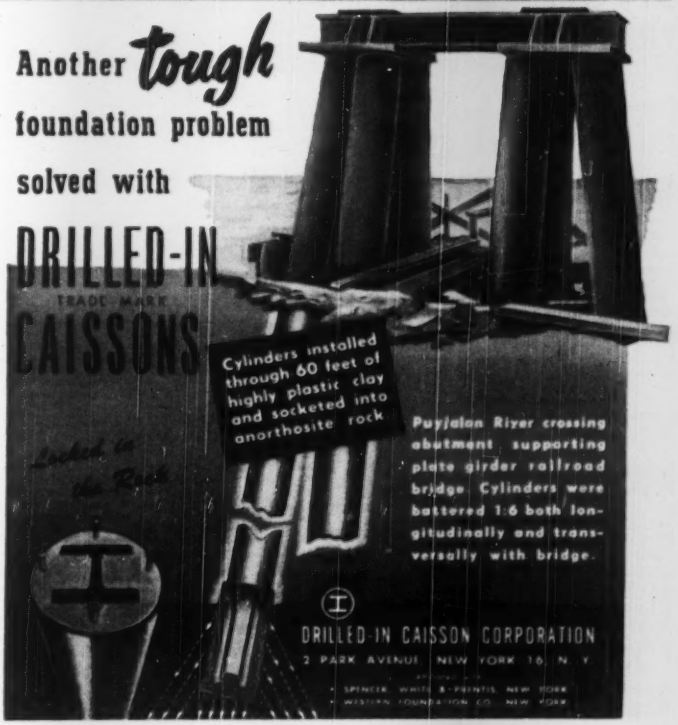
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CATALOG DIGESTS

87 POLAROID

The Polarizing Instrument Company, Inc.—A 4-page pamphlet illustrating and describing photoelastic polariscope for stress determination and the universal straining frame for photoelastic analysis is offered to the machine designer whose photoelastic stress analysis is not only of value in the verification of calculations based on theoretical solutions, but also in the solution of problems where theoretical analysis is not available.

88 POWER GRADERS

Austin-Western Co.—A 24-page catalog AD-2112 pictures and describes the "88-H," the "99-H" and the Master "99" power graders with exclusive all-wheel drive and all-wheel steer. All types of work—rough grading, heavy ditching, scarifying, snow plowing, terracing and drainage, mixing, loading, rolling and bulldozing—are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

89 PRELIMINARY SURVEY PROCEDURE

American Paulin System—This booklet, available without charge to all civil engineers, is published in the interests of greater efficiency and economy of time and labor in the making of preliminary surveys under all conditions. The observer and author of this work, Raymond A. Hill, M. ASCE, explains in detail the practical use of the Paulin System Altimeter in connection with all branches of preliminary field surveying. Geologists, scientists, topographers, surveyors and educators will find this book of interest and technical value.

90 PRESSURE-CREOSOTED PILES

Koppers Co.—A 16-page booklet designed to assist engineers in the evaluation of pressure-creosoted foundation piles for various types of construction projects has been issued. The booklet cites important national, regional, and city construction codes which allow pressure-creosoted wood foundation piles for permanent construction. Typical examples of the use of these piles are described and pictured.

91 PUMP

Fairbanks, Morse & Co.—The 16-page bulletin 5400k-1, with illustrations and complete description of bladeless sewage and trash pump showing the bladeless impeller in cross section and phantom is available. Complete details of construction are included with cross-section drawings showing casing, volute, and bladeless impeller. Descriptions of both vertical and horizontal pumps are shown, as well as principal dimensions of both types, and selection tables.

92 PUMPS

Layne & Bowler, Inc.—A 16-page bulletin "Layne Short Coupled Service Pumps," contains cut-away drawings of pump bowls and discharge columns. Sixteen sketches show the Layne vertical turbine pump applied to river and re-lift service, boosting, recirculation, cooling tower, drainage, gas and oil pumping, and fire pumps.

93 RACK RAKE

Newport News Shipbuilding and Dry Dock Co.—The illustrated 15-page booklet outlines uses for the Newport News mechanical rack rake, a power-operated rake for cleaning trash racks at water intakes for hydroelectric plants, steam plants, pumping stations, canals, and similar installations. Included in the booklet are drawings for a number of typical installation arrangements.

94 REPRODUCTION METHODS

Eastman Kodak Co.—A 72-page Data Book on the use of Kodagraph reproduction materials for office photocopying and engineering reproduction has been published. Diagrams in the new edition graphically illustrate methods of solving special reproduction problems and both techniques and equipment are explained. Techniques of copying familiar business documents are fully explored and the book outlines suggested methods of organizing an effective photocopy unit. The price is 50 cents.

N. B. There is a charge for this book. Make checks payable to the Eastman Kodak Co.

95 RESTO-CRETE SYSTEM

Western Waterproofing Co.—has a catalog on the maintenance and restoration of concrete storage tanks by the Resto-Crete system. It tells how to recognize concrete deterioration, what causes damage to concrete masses, and how the system provides lasting protection.

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96 RULING PENS

Keuffel & Esser Co.—Leaflet describes Marathon long line and wide line pens, which draw five to eight times more line between fillings than ordinary ruling pens. Five pre-set widths draw uniform lines from .009 to .060 in. width. Easy to handle for guided curve lines or freehand contour line work. Can be laid down filled without leaking.

97 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81 with supplements A and B describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems either by cutting off such flows entirely during storm periods or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

98 SIMPLEX EQUIPMENT

Simplex Valve & Meter Company—A general description of the complete line of Simplex equipment is offered in Bulletin 002. The bulletin describes and illustrates Venturi tubes, rectangular and circular chart type meters, controllers and gauges and methods of auxiliary close-off devices. It illustrates type "S" parabolic flume, W-K tap arrangements, manometers, pilot equipment, air inlet and air release valves.

99 SINKER DRILL

Gardner-Denver Co.—A folder on a 45-lb class sinker of advanced design has just been announced. Known as the S48, this sinker is said to have superior drilling, rotating and hole cleaning characteristics that make it especially suitable for use with modern tungsten carbide rock bits.

100 SNOW EQUIPMENT

Caterpillar Tractor Co.—A 16-page booklet "Beat Back the Snow with Caterpillar Equipment" will be of interest to city, county and state highway departments and road commissions, as well as individual contractors responsible for snow removal operations within their area. Under actual working conditions the photographic scenes show how maintenance crews and snow removal equipment keep the nation's highways, farm-to-market roads, and city streets open to traffic during the winter months.

101 SNOW PLOW-POWER GRADER

Austin-Western Co.—Bulletin AD-2092 describes the Sicard rotary snow master, used as an attachment with power graders. The advantages of 4-wheel drive and steer in connection with rotary snow plow operation are fully discussed and illustrated. The controllable wrist-action telescopic casting chute of the snow master is shown handling all types of snow removal including loading trucks from either side. This catalog describes and pictures snow removal under almost every condition both in opening and widening streets and highways. Brief specifications are also included.

102 SOIL SAMPLING EQUIPMENT

Sprague & Henwood, Inc.—The most complete publication on soil sampling equipment is found in Bulletin No. 75-A. Types of samples, value of samples and sample testing are described in this bulletin as well as equipment recommended for the taking of the actual sample in various formations.

103 SOLVING CONSTRUCTION PROBLEMS

Merritt-Chapman & Scott Corp.—A 12-page, 2-color booklet acts as a guide to constructor selection by giving an analysis of major factors controlling success of building projects and the importance of constructor's experience, personnel, adaptability, financial responsibility and reputation in execution of your plans, specialist skills for special needs, speed that meets deadlines, pinpoint accuracy, "know-how" that solves intricate problems, efficiency that saves money and half-tones of new, interesting jobs, are all included in this booklet.

Turn to page 78 and order your literature.

104 SPEED-LAY PIPE SYSTEMS

Albert Pipe Supply Co., Inc.—A 5-page brochure describing "packaged" pipe line for temporary and semi-permanent air, gas and water lines is offered. This line is available in sizes 2 to 12 in., or larger if desired. It is lightweight, portable, easily assembled and available for prompt shipment. Includes pipe, couplings, fittings, adapters and valves where necessary.

105 STABILIZED ROADS

Harnischfeger Corp.—Booklet S-8 tells why the "World-Wide Trend to Stabilized Roads Means Many More Miles from Tight Budgets." Its treatment presents on-the-job photos, facts and results on stabilization jobs involving soil-asphalt, soil aggregate and soil-cement throughout the United States, Africa and England.

106 STAINLESS STEEL TUBING

Republic Steel Corp.—A 27-page catalog on Electrunite Enduro stainless steel tubing tells how it serves, describes the types of tubing, features, applications, fabricating data, tubing data tables, engineering data, specifications, a size range chart, and other steel and tube products.

107 STEEL BEARING PILES

Carnegie-Illinois Steel Corp.—A 100-page book presents comprehensive data and illustrations of the current practice in the design and use of the new steel CBP section bearing piles. In addition, there is an extensive review of the use of steel bearing pile sections, with records of tests of the past uses and applications.

Kansas reports...

THE UNIVERSITY OF KANSAS
STATE GEOLOGICAL SURVEY
LAWRENCE

RAYMOND C. MOORE
State Geologist and Director of Research

JOHN C. FRYE
Executive Director

July 27, 1950

American Paulin System
1847 South Flower Street
Los Angeles 15, Calif.

Gentlemen:

In May of this year we received a shipment of three new Micro Altimeters, Model M-1, from your company to be used by the State Geological Survey of Kansas in obtaining oil, gas, and water well elevations.

A certain degree of accuracy is needed in these elevations in order that they may be used in the future for correlation purposes. Also we wanted to obtain the elevations as rapidly as possible and still be within certain limits of accuracy.

A test traverse was run with one of the instruments in which the points chosen were all United States Geological Survey Bench Marks on which the elevations were previously known. One of these bench marks was used as a control point and the elevations of the rest were disregarded while running the traverse. Three readings were taken on the control point and two readings were taken on the rest of the points.

Particular caution was taken in making each reading in order to obtain the greatest amount of accuracy possible. Temperature corrections and barometric corrections were made with equal care.

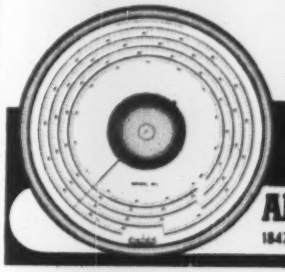
Upon completion of the statistics it was found that on four of the points an error of only one foot had been made from the actual elevation and on one of the points the computed elevation was exactly the same as the actual elevation.

It is believed that with further practice in reading the instrument an even greater degree of accuracy can be obtained. We are completely satisfied with the performance of the American Paulin System Micro Altimeters and feel justified in highly recommending them for accurate reconnaissance elevation work.

Yours truly,

R. Kenneth Smith

R. Kenneth Smith



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CATALOG DIGESTS

108 STEEL FLOORING INSTRUCTIONS

William F. Klemp Co.—offers its 1950 edition of a new technical manual entitled, "Instructions for Laying Klemp Heatcel and Floorsteel." Heatcel heavy-duty surface armor is an open-steel grid, solid, enduring and self-anchoring. Floorsteel, flexible floor armor is an open steel mat. Both are used to armor and reinforce bridges, docks, air landing strips, loading platforms, industrial floors, heavily traveled highways and catalytic cracking units. The book contains complete engineering data.

109 STEEL SHEET PILING

Carnegie-Illinois Steel Corp.—A 56-page booklet gives detailed discussion of the uses, characteristics, and assembly of the three general types of steel sheet piling sections: the straight web, the arch web, and Z-piles. Following this discussion are complete tables of wall dimensions, cellular structures, accessories, and weights for all sections, plus diagrams of the individual sections, walls, corners, cellular structures, cofferdams, bulkhead and piers, and caps or copings.

110 STEEL TUBING

Republic Steel Corp.—The booklet describes Elyria structural steel tubing, and lists its characteristics. Two pages are devoted to fabricating data, and standard sizes and wall thicknesses are shown in tables.

111 STRUCTURAL SHAPES

Carnegie-Illinois Steel Corp.—Attractive 72-page book, "Hot Rolled Carbon Steel Structural Shapes," contains complete properties and dimension tables of all available structural shapes, including diagram drawing of each. Also includes plate size limitations and basic structural data on bearing piles, steel sheet piling, floor plate, crane rails, and corrugated sheets.

112 SUMP PUMPS

Economy Pumps, Inc.—Construction details, applications, and detailed installation drawings of Economy VSL and VS general service sump pumps are featured in a new catalog. These pumps are suitable for automatic drainage of pits, basements, and similar constructions. A selection table for specific application of pumps, ranging in capacity from 30 to 150 U. S. gal per min is contained in Catalog No. E 748.

113 SURVEYING ALTIMETER

American Paulin System—has a catalog giving specifications on Micro and Terra surveying altimeters together with comparative explanation of instrumentation systems in this field.

114 SURVEYING ALTIMETER DEVELOPMENT

American Paulin System—offers their interesting and instructive publication entitled "Origin and Development of the Barometer and Altimeter." This booklet will acquaint civil and field engineers with the basic differences between their system of instrumentation and all other types in the field of surveying altimeters.

115 SURVEYING INSTRUMENTS

C. L. Berger & Sons—Catalog "F" describes the full Berger line of transits, levels, theodolites, alidades and special instruments made by that company for 80 years. A well illustrated brochure (N 648) is available on request for preliminary information.

116 SURVEYING INSTRUMENTS

Norbert Dienstfrey—A series of booklets covering the Fennel's Universal Theodolite is offered. Included in the series are booklets on the optical plumb, reading of both circles adjacent to telescope, illumination, Hammer-Fennel auto-reduction tacheometer, light dumpy levels, precise levels, 4-in transit and 5-in precise transits, alidades, balloon-theodolites and suspension-theodolites. The instruments are lightweight, totally enclosed and field work time-saving is up to 50%.

117 SURVEYING INSTRUMENTS

David White Co.—The 40-page Bulletin No. 1050, containing information on engineers, surveyors and builders instruments is available. In addition to this, alidades, plane tables, etc., are fully listed.

TIDE GATES

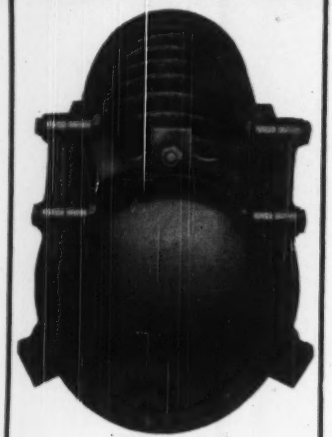

FIG. B-147

Type M-5 Tide Gates for use with Corrugated Culvert Pipe. Bulletin No. 91 describes them fully.

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CATALOG DIGESTS

118 SWIMMING POOL EQUIPMENT

Permutit Company—Complete information and specifications are contained in Bulletin 2137 on Permutit recirculation and purification equipment. This includes information on alum and alkali feeds, filters, rate of flow controllers, automatic pH controls, chlorinators, test kits, suction cleaners and zeolite water softeners.

119 TECHNICAL BOOKS

John Wiley & Sons, Inc.—Information on authoritative, up-to-date technical books in all branches of science and engineering is available in the Wiley general catalog. Of particular interest to civil engineers are the descriptions of standard reference and textbooks on structural engineering, foundations, hydraulic and hydroelectric engineering, municipal engineering, architecture, irrigation, highway and bridge engineering, building construction, and many other related subjects.

120 TESTING EQUIPMENT

Rainhart Co.—has condensed data regarding both field and laboratory equipment, produced exclusively by this manufacturer, for accurately determining physical characteristics of soils, concrete and other materials. Also, current bulletins covering additional equipment being developed and other data of particular interest to those engaged in testing materials are offered.

121 TIDE GATES

Brown & Brown, Inc.—Bulletins 69 through 73, 75 and 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

122 TRACING PENCIL TEST KIT

American Lead Pencil Co.—The kit contains samples of Venus tracing pencils for testing on various types of tracing papers. This new pencil contains an active chemical to produce clearer, sharper white or blue prints when reproduction is made from a pencil drawing.

123 TRACTORS

Allis-Chalmers Mfg. Co.—A 20-page booklet featuring a complete industrial tractor line has just been released. The two-color catalog contains specifications and a brief description of each Allis-Chalmers power unit, wheel tractor and crawler tractor. It emphasizes wise use of equipment, and discusses the importance of buying the right equipment "to fit" your jobs.

124 TRAILER-MOUNTED PORTABLE COMPRESSORS

Gardner-Denver Co.—A line of easily handled trailer-mounted portable compressors has been developed. Designed especially for operating small air tools on miscellaneous service jobs, these new compressor units are said to be ideal for painting contractors, stone masons, monument workers, public utilities and industrial plants.

125 1950 TRUCKS

Ford Motor Company—A comprehensive illustrated and diagrammed folder presents the latest model Ford trucks. Discussed within the folder are special features, proof that Ford trucks last longer, "bonus built" construction, engine and cab features, and chassis and engine specifications. Each model is pictured and its particular features thoroughly explained.

126 TUBES

Republic Steel Corp.—A 19-page catalog on Republic electrunite tubes is offered. The advantages are listed, and a pictorial presentation of the processes employed in the production of pressure tubes is shown. Specifications and approvals, and a table of maximum allowable working pressures are included.

127 TUNNEL EQUIPMENT

Mayo Tunnel Equipment Co.—Steel forms, air locks and tunnel shields built for Central and South America are shown in Bulletin No. 14.

128 TUNNEL EQUIPMENT

Mayo Tunnel Equipment Co.—Bulletin No. 15 illustrates and describes the Mayo steel forms, air locks and tunnel shields as furnished for jobs in this country.

Relieving platform, which supports New York's East River Drive, rests on 72,000 creosoted piles. Wood form, pictured here, carries reinforced concrete slab.

72,000

CREOSOTED PILES SUPPORT NEW YORK'S EAST RIVER DRIVE!

New York's East River Drive, completed in 1942, is one of the city's most impressive waterfront parkways. This Drive is about 7 miles long; in six lanes, it carries two-way high-speed traffic. For a distance of 4.3 miles, relieving platform bulkheads were built along the shore of the East River to support the highway. These relieving platforms rest on approximately 72,000 creosoted timber piles, driven offshore in water 20 to 30 feet deep.

The engineers specified pressure-creosoted piles because of their economy and permanence. These piles are usually lower in cost than other permanent pile materials. The pressure-creosoting treatment protects them against marine borers; also, against decay and insect attack where cutoffs are above the water table.

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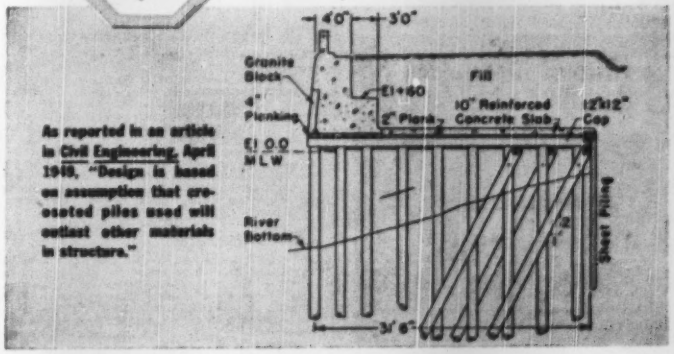

As reported in an article in Civil Engineering, April 1949, "Design is based on assumption that creosoted piles used will outlast other materials in structure."

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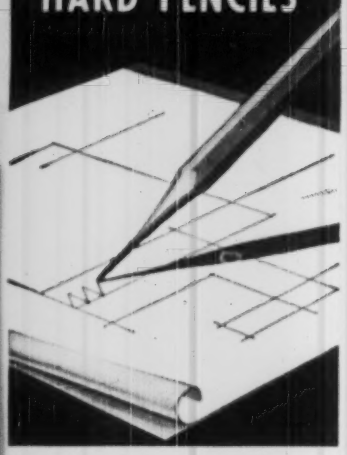

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CATALOG DIGESTS

129 TUNNELING

Commercial Shearing & Stamping Co.—Now available is a text book on tunnels and an introduction to tunnel geology by tunnel men. Entitled "Rock Tunneling with Steel Supports" by Karl Terzaghi, the book deals with specific information on tunneling, covering 800 subjects. The most comprehensive book of its type ever offered to the tunnel builder and designer. Price $2.50 per copy postpaid.

N. B. There is a charge for this book. Make checks payable to the Commercial Shearing & Stamping Co.

130 UNDERWATER SURVEY INSTRUMENT

Bludworth Marine, Div. of National-Simplex-Bludworth—A brochure describing the Model ES-123 supersonic echo depth recorder and its application is offered. Survey groups and others engaged in dredging, excavation, and various silt studies will find this underwater survey equipment most interesting. The instrument provides a permanently recorded graph of underwater contours as well as the consistency of bottom materials. Price: $3,300 and up.

131 VACUATOR

The Dorr Co.—The 12-page, two-color Bulletin No. 6301, entitled "The Dorreo Vacuator" describes the modern unit in detail including installation photos, drawings and flowsheets illustrating its various applications in sewage treatment. The vacuator is a compact unit utilizing the principle of vacuum flotation and is giving remarkable results on a wide variety of municipal and industrial wastes.

132 VALVES AND FITTINGS

M & H Valve & Fittings Co.—Circular 49 gives important information and installation dimensions of M & H AWWA mechanical joint valves and hydrants, also mechanical joint cutting-in sleeves and post indicator valves, approved by Underwriters and Associated Factory Mutuals.

133 VARIABLE SPEED DRIVES

Link-Belt Co.—The 88-page Book No. 2274 covers P I V variable speed drives, available in 8 sizes and 16 types, in horse powers of ¼ to 25. There are 36 pages of preselected drives. Selection of proper drive has been made easy. Both manual and automatic controls are illustrated and described.

134 VENTURI METER

Simplex Valve & Meter Co.—Bulletin No. 400 describes in detail the operation and installation methods of the type H meter register. This is a circular-type chart instrument equipped with various forms of mountings and arranged for operation under the majority of hydraulic head conditions. A complete pipe size and meter capacity table provides a quick and ready reference when needed. This bulletin is of essential interest to any filter plant or sewage plant designing engineer.

135 VIBRATORS

Viber Co.—New applications and equipment development on interchangeable vibrator units, flexible drive, full depth internal concrete paving, rubber-tipped and Model PX-6 external vibrators are described in a recently published catalog. Specifications concerning speeds, weights, sizes, types of power, etc., are included.

136 WATER CONDITIONING DATA BOOK

The Permutit Company—has compiled a data book which includes complete information and tables on: Hydraulics; hardness of water; chemical conversions; coagulation; acid and alkali dosages; chemicals used in water treatment; sodium chloride solutions; Zeolite, Zeo-Karb H and De-Acidite reactions; Hot Lime Soda Process, sodium sulfite, ferrous sulfate and phosphate dosages; boiler feed makeup; saturated steam, temperatures, pH values; solubility of oxygen and air, etc. The new edition of this Data Book is practically a necessity to practicing engineers interested in water conditioning problems!

137 WATER FILTERS

Proportioneers, Inc.—Bulletin 1800 describes Pur-O-Cel Diatomite filters for use in filtration of water in municipal and industrial water works and in swim pool recirculation systems. Engineering data on the application of these filters, including specification and dimensions covering the complete recirculation and purification systems, are given.

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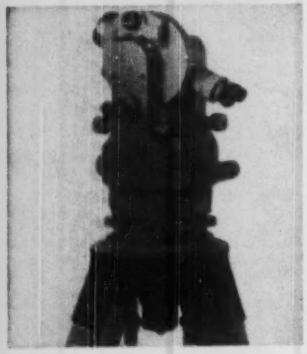

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CATALOG DIGESTS

138 WATER POWER EQUIPMENT

Newport News Shipbuilding & Dry Dock Co.—An exceptionally attractive book, consisting of 75 pages, is offered free of charge to engineers interested in hydraulic turbines, butterfly valves, pressure regulators, penstocks, regulating gates and trash rakes. The booklet shows various plants throughout the United States using this equipment. Pictures, details of the development, sectional views, and an interesting synopsis of the company's hydraulic laboratory are included.

139 WATERPROOFING

Western Waterproofing Co.—A 4-page folder tells how lasting protection and beauty for your school property can be obtained through weather and water damage protection, building restoration, concrete restoration, tuckpointing and building cleaning.

140 WATERPROOFING AND WEATHERPROOFING

Western Waterproofing Co.—The 4-page, 2-color folder tells how the company's complete weatherproofing services protect and preserve your buildings through tested methods, trained mechanics and superior materials.

141 WATERPROOFING AND WEATHERPROOFING

Western Waterproofing Co.—Weatherproofing service for railroad properties is presented in a 4-page folder. Rehabilitation of older masonry structures, as well as preventive measures for new construction projects, is accomplished most economically and effectively through the specialized services summarized in the folder.

142 WELLPOINT SYSTEM

Complete Machinery & Equipment Co., Inc.—A catalog describing the Complete Wellpoint System, shows its many advantages in installation, operation and cost-cutting economy. Also suggestions for installing the system are clearly stated and illustrated.

143 WELLPOINT SYSTEM

Moretrench Corp.—"Working in the Dry with the Moretrench Wellpoint System" is the title of a 64-page catalog describing and illustrating the Wellpoint system and its use in dewatering various types of construction projects. It is amply illustrated with on-the-job photos.

144 WELLPOINT SYSTEM

John W. Stang Corp.—A new catalog on wellpoints is being issued. It contains illustrations and descriptions of many dewatering jobs. The booklet shows the use of Stang methods and equipment employed in small and large projects.

145 WELDED FABRIC

Wickwire Spencer Steel Div. Colorado Fuel & Iron Corp.—A 2-color folder describes Clinton electrically welded fabric which has been successfully applied to every form of reinforced concrete construction. Some of its many uses are for concrete roads, streets, airports, floors, pipe, sewers and reservoirs. Structural advantages, ease of use and standard styles are listed.

146 WIRE ROPE

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—The new Wickwire rope catalog offers a different approach to this difficult subject. Charts, tables, drawings, and photographs were included to present a fresh slant on wire rope. The catalog covers the characteristics, care, handling and describes wire rope for specific industries.

147 WIRE ROPE—LIFE AND COSTS

Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.—Thousands of wire rope users—old hands and new—have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78 "right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts.

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Closed to Further Discussion

6. Slope Deflection Equations for Curved Members by Keith T. Fowler, Jun. M. ASCE.

7. The Geochemistry of Earthwork by Hyde Forbes, M. ASCE.

8. Floating Tunnel for Long Water Crossings by Charles E. Andrew, M. ASCE.

9. Atchafalaya River Diversion and Its Effect on the Mississippi River by Leo M. Odom, M. ASCE.

10. Pollution Abatement Policy by Thomas R. Camp, M. ASCE.

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12. Influence Charts for Concrete Pavements by Gerald Pickett and Gordon K. Ray, Jun. M. ASCE.

13. Reinforced Concrete Skewed Rigid-Frame and Arch Bridges by Maurice Barron, M. ASCE.

14. Mathematical Analysis of an Aerial Survey by Lo-Ho.

15. Computation of Equitable Charges for Treatment of Municipal Sewage by Ellis E. Bankson, M. ASCE.

D-VII. Discussion of Paper, **Deflection of Plywood Beams Due to Moisture Content Change,** by W. E. Wilson and Laurence G. Olson.

16. Pavement Bearing Capacity Computed by Theory of Layered Systems by Guthlac Wilson, M. ASCE, and G. M. J. Williams, Jun. M. ASCE.

17. Origin and Significance of Openwork Gravel by Allen S. Cary, Assoc. M. ASCE.

18. Successive Approximations for Beams on an Elastic Foundation by E. P. Popov, Assoc. M. ASCE.

19. Flood-Control Operation of Tennessee Valley Authority Reservoirs by Edward J. Rutter, M. ASCE.

20. Three-Dimensional Displacement Diagrams for Space Frame Structures by Walter Worthington Ewell, Jun. M. ASCE.

Summarized in Earlier Issues

21. Maximum Load Capacity of Bailey Bridges by Robert B. Stegmaier, Jr., Jun. M. ASCE.

22. Specifications for Heavy Duty Structures of High-Strength Aluminum Alloy, Progress Report of the Committee of the ASCE Structural Division on Design in Lightweight Structural Alloys.

23. Influence of Heavy Loads on Pavement Design Trends by K. B. Woods, M. ASCE.

24. Summary of Buckling of Rigid-Jointed Plane Trusses by N. J. Hoff, Bruno A. Boley, S. V. Nardo, and Sara Kaufman.

25. Uplift Pressures in Concrete Dams by Kenneth B. Keener, M. ASCE.

D-XVI. Discussion of Paper, **Stream Flow Variability,** by E. W. Lane and Kai Lei.

D-XVII. Discussion of Paper, **End Restraints on Truss Members,** by Harold E. Wessman and Thomas C. Kavanagh. Critical and constructive comment was received from Jack R. Benjamin, George Winter, Abraham Slavin, J. Edmund Fitzgerald, Joseph S. Newell, and Charles W. Dohn. The authors' closure should be read with interest by everyone concerned with the practice and theory of structures.

D-XVIII. Discussion of Paper, **Frequency Analysis of Beam and Girder Floors,** by Hans H. Bleich.

D-XIX. Discussion of Paper, **Roads and Pavements, Sampson Naval Training Station,** by Jacob Feld.

D-XX. Discussion of Paper, **Aerodynamic Theory of Bridge Oscillations,** by D. B. Steinman.

26. Industrial Stream Pollution Abatement, by L. L. Hedgepeth.

27. Plasticity of Metals—Mathematical Theory and Structural Applications, by D. C. Drucker, Assoc. M. ASCE.

28. Retrogression on the Colorado River Since 1935, by J. W. Stanley.

29. Sedimentation Studies at Conchas Reservoir in New Mexico, by D. C. Bondurant, Assoc. M. ASCE.

30. Economic Effects of Reservoir Sedimentation, by W. E. Corfitzen, M. ASCE.

31. Measurement and Analysis of Suspended Sediment Loads in Streams, by Martin E. Nelson and Paul C. Benedict.

32. Effect of Skew Angle on Rigid-Frame Reactions, by Walter C. Boyer.

33. Strength of I-Beams in Combined Bending and Torsion, by Basil Sourochnikoff.

34. Lateral Buckling of Eccentrically Loaded I-Section Columns, by H. N. Hill and J. W. Clark.

35. Design Curves for Footings on Soil, by Winfield A. McCracken.

Third Notice

D-XXII. Discussion of Paper, **Analytical Method of Determining the Length of Transition Spiral,** by Michael V. Smirnoff. The original paper, published in November 1949 PROCEEDINGS (p. 1283), presented a step-by-step approach to the problem of expressing the length of transition spiral. Discussion by T. F. Hickerson, Thomas R. Klingel, Carl F. Meyer, Joseph Barnett, J. J. Leeming, Allen G. Tyson, Donald Thompson, and Ralph A. Moyer, and the author's closing arguments, will be read with keen interest by specialists in the field. (Available October 1.)

D-XXIV. Discussion of Paper, **Diversion Tunnel and Power Conduit of Nantahala Hydroelectric Development,** by D. J. Bleifuss. The original paper, published in December 1949 PROCEEDINGS (p. 1409), gave, in detail, the salient design considerations of a part of a great hydroelectric project in North Carolina. A thorough discussion by Joseph R. Bowman emphasizes the particular problems of energy dissipators, gate guide alinement, gate-opening devices, the power intake gate hoist, the pipe line, penstock, and surge tank. Each of these topics is taken up in turn in the author's brief closing discussion. (Available October 1.)

Second Notice

36. Impossibility of Performance in Contracts for Engineering and Construction, by

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Robert F. Borg. When will an agreement for a project be excused as impossible of performance? A practicing contracting engineer (who is also a member of the New York State Bar) examines, from an engineer's point of view, a problem that has resulted in many law cases. The established rule forbids excuse for impossibility, but the numerous and various exceptions are grouped and described. The purpose is to enlist the discussion and aid of the engineering profession in assisting the courts to solve this ever difficult problem. (Available November 1.)

37. Design of Prestressed Tanks, by J. M. Crom. The author's experience in supervising the design and construction of more than 500 prestressed circular concrete tanks forms the basis of this analysis of the design principles involved. Substantial losses of stress occur in the prestressing steel as a result of shrinkage and plastic flow in the concrete. With low initial stresses in the prestressing steel, after deducting losses due to shrinkage and plastic flow, the effectiveness of prestressing is largely nullified. This emphasizes the advantages in prestressing with high-strength steel wire having initial design stresses of about 150,000 lb per sq in. (Available November 1.)

38. Hydrology of Mexico, by Andrés García-Quintero. All the factors that must be considered to account for the relative scarcity of rainfall in Mexico—such as geographical position in relation to air currents, cyclones, and air masses; topography; and mountain ranges that determine distribution of rainfall and consequently hydrology—are reviewed. The paper is completed by a table of maximum discharges observed in Mexican rivers and graphs that will enable comparisons with rivers of other countries. (Available November 1.)

39. Practical Design of Solid-Barrel, Reinforced-Concrete Skew Structures, by Bernard L. Weiner. The purpose of this paper is to show that, with sufficient accuracy for design purposes, the work involved in designing a skew structure may be reduced to little more than that required for a similar right-angle structure. Part of the work is reduced by making certain approximations which are permissible because of the stress characteristics of the skew structure. The work is further reduced by taking advantage of factors that follow directly from consideration of static equilibrium and are independent of skew-arch theories. (Available November 1.)

40. Technique of Passing Floods Over Earth Dams During Construction, by Andrew Weiss. An unvarnished account of success and partial failure in permitting flood flows to pass unhindered over uncompleted earth and rock-fill dams during construction is offered by the author. This necessity arises when absence of sufficient hydrologic data renders conventional by-pass provisions unsafe, as in Mexico, where rates of flood discharge in many streams are wholly unpredictable. The technique employed by Mr. Weiss (the originator) and his associates has demonstrated its practicability to a degree which invites consideration by engineers elsewhere. (Available November 1.)

D-XXVI. Discussion of Paper, **A Study of End Connections for Struts,** by Marshall Holt and J. W. Clark. The original paper, published in December 1949 PROCEEDINGS (p. 1477), presented the results of tests to evaluate the effect of different types of end connections on the static and fatigue strengths of struts. Interesting comment was received from Jack R. Benjamin, James W. Harland, F. P. Shearwood, and S. K. Ghaswala, and the authors contribute a brief closing discussion. (Available November 1.)

First Notice

41. Ship Response to Range Action in Harbor Basins, by Basil Wrigley Wilson. In many harbors the troublesome movements of ships are the results of range or surge action. The paper treats the conditions prevailing at Capetown, South Africa, but its generalizations are applicable almost anywhere. The influences of moorings, size, draft, and location of a ship in a harbor are examined with reference to longitudinal and transverse surging, and the conditions of resonant response are evaluated. Theoretical deductions are confirmed by model experiments and prototype measurements. The periods of dangerous surges are defined and suggestions are offered for eliminating or minimizing the motion. (Available December 1.)

42. Wind-Load Standards in Europe, by John W. T. Van Erp. Since some decades it has been endeavored to obtain a more accurate picture of wind loads on buildings and structures, about which little precise data existed. As the utmost economy in the amount of material used has always been more necessary in Europe than in the United States, investigation of the exact nature of wind loads has been more advanced than in this country. This paper reviews various aspects of the problem and the way in which safety standards have been determined. (Available December 1.)

43. Settlement Correction at La Guardia Field, by John M. Kyle. After its establishment as an airport for the City of New York, N.Y., a part of La Guardia Field was observed to settle. On several occasions prior to August 1946, unusual storms and high tides drove sea water over this area, making it unfit for use during considerable periods. The paper describes the sequence of construction operations required to correct the situation. (Available December 1.)

44. The Problem of Wave Action on Earth Slopes, by Martin A. Mason. Wave action on earth slopes and the possible application of wartime developments to the knowledge of wave action, particularly in regard to methods for the prediction of wave action, is discussed in this paper. The Sverdrup-Munk method of predicting wave height and period from synoptic weather maps is recommended as a substitute for the older purely empirical methods. The Iribarren formula for the calculation of sizes of stone required on various slopes for protection against wave action is suggested as the only available satisfactory method of design. (Available December 1.)

45. Comprehensive Plan for the Columbia Basin, by William Whipple. Cooperative planning of several government agencies has resulted in congressional authorization of an unprecedentedly large system of multiple-purpose reservoirs and related works for the Columbia Basin. The Grand Coulee, Bonneville, and McNary projects are only initial units of this system, which will ultimately have a 10,000,000-kw output. The planning involved a variety of different problems including preservation of migrating salmon, priorities of water use for irrigation, and reliable flood control in a multiple-purpose system. (Available December 1.)

D-4. Discussion of Paper, **Capillary Phenomena in Cohesionless Soils,** by T. William Lambe. The original paper, published in February 1950, explained the fundamentals of capillarity in cohesionless soils. Discussers are: M. R. Lewis, Peng Swe-tze, D. P. Krynine, and T. William Lambe. (Available December 1.)

D-5. Discussion of Paper, **Elastic Restraint Equations for Semi-Rigid Connections,** by J. E. Lothers. The original paper, published in February 1950, discussed the restraining effects of semirigid, girder-column connections. Discussers are: Lloyd T. Cheney, Thomas C. Kavanagh, Dean F. Peterson, Jr., and Jack E. Certmak, and J. E. Lothers. (Available December 1.)

D-10. Discussion of Paper, **Pollution Abatement Policy,** by Thomas R. Camp. The original paper, published in March 1950, outlined a policy to guide engineers and others interested in pollution abatement. Discussers are: J. E. McKee, Elwood L. Bean, and Thomas R. Camp. (Available December 1.)

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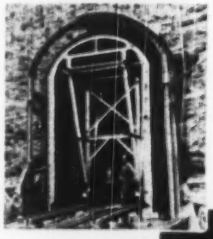

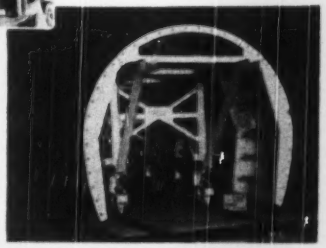

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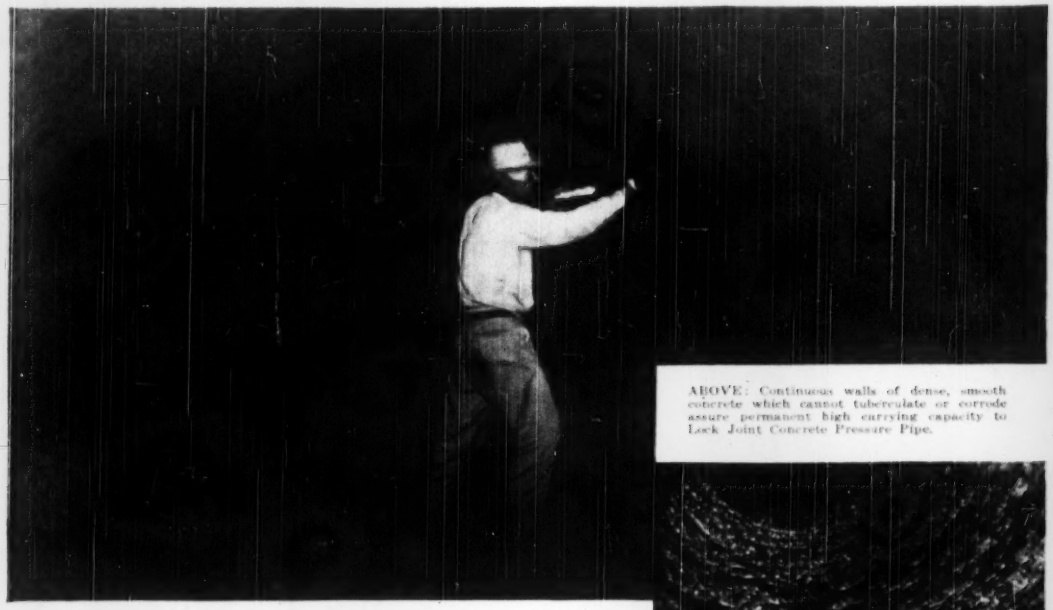

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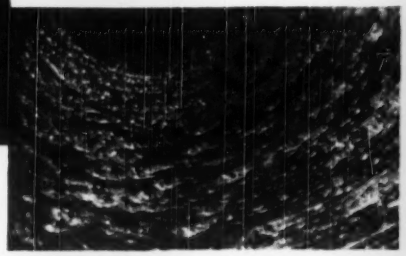

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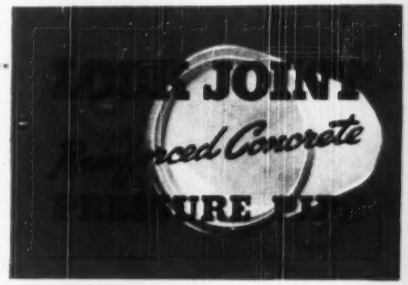

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